

Simple  friendly



**Kawasaki Robot Controller  
E Series**

**Installation and  
Connection Manual**

**-Arc Welding-**

**Robot**

**Kawasaki Heavy Industries, Ltd.**

## PREFACE

This manual describes installation and connection procedures for Arc Welding Robot which is controlled by Kawasaki Robot E series controller.

Read and understand the contents of this and safety manuals thoroughly and strictly observe all rules for safety before proceeding with any operation. Installation and connection methods in this manual apply only to arc welding equipment. Read this manual together with the following manuals: Installation and Connection for Robot Arm, and Installation and Connection for Controller.

This manual is applicable to the following robots.

RA05L E71/74/77  
RA06L E20/30/40/01  
RA10N/L E20/30/40/01  
RA20N E20/30/40/01

- 
1. This manual does not constitute a guarantee of the systems in which the robot is utilized. Accordingly, Kawasaki is not responsible for any accidents, damages, and/or problems relating to industrial property rights as a result of using the system.
  2. It is recommended that all personnel assigned for activation of operation, teaching, maintenance or inspection of the robot attend the necessary education/training course(s) prepared by Kawasaki, before assuming their responsibilities.
  3. Kawasaki reserves the right to change, revise, or update this manual without prior notice.
  4. This manual may not, in whole or in part, be reprinted or copied without the prior written consent of Kawasaki.
  5. Store this manual with care and keep it available for use at any time. If the robot is reinstalled or moved to a different site or sold off to a different user, attach this manual to the robot without fail. In the event the manual is lost or damaged severely, contact Kawasaki.
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## SYMBOLS

The items that require special attention in this manual are designated with the following symbols.


Ensure proper and safe operation of the robot and prevent physical injury or property damages by complying with the safety matters given in the boxes with these symbols.

 **DANGER**

**Failure to comply with indicated matters can result in imminent injury or death.**

 **WARNING**


**Failure to comply with indicated matters may possibly lead to injury or death.**

 **CAUTION**

**Failure to comply with indicated matters may lead to physical injury and/or mechanical damage.**

[ **NOTE** ]

Denotes precautions regarding robot specification, handling, teaching, operation, and maintenance.

 **WARNING**

- 1. The accuracy and effectiveness of the diagrams, procedures, and detail explanations given in this manual cannot be confirmed with absolute certainty. Accordingly, it is necessary to give one's fullest attention when using this manual to perform any work.**
- 2. Safety related contents described in this manual apply to each individual work and not to all robot work. In order to perform every work in safety, read and fully understand the safety manual, all pertinent laws, regulations and related materials as well as all the safety explanations described in each chapter, and prepare safety measures suitable for actual work.**

## SAFETY

When installing and connecting the Arc Welding Robot, carefully read the following precautions together with the safety precautions in the Installation and Connection for Robot Arm and Controller.

### INSTALLATION ENVIRONMENT OF ROBOT ARM

1. Install the safety fence in consideration of not only the motion range of the robot arm but also the distance that protects operators/personnel from any possible exposure to arc spatter.
2. Provide light shield in order to protect operators/personnel from arc burning and eye injury caused by direct viewing of arc beam.
3. Do not put any flammable/combustible materials around the Arc Welding Robot.

### INSTALLATION OF THE ROBOT ARM

1. Be sure to isolate the robot arm from the torch and welding wires.

### INSTALLATION & CONNECTION OF CONTROLLER

1. Provide an external power switch exclusively for the robot. Do not share the switch with the welder and other equipment.
2. Use the dedicated earth (100  $\Omega$  or less). Never share the earth with welder, etc. for earthing wire or earthing electrode.
3. Never wire the motor cable and the signal cable through under the welder.
4. To avoid influence by electromagnetic noises generated from welding arc, install precision equipment, etc. away from welding arc and supply input power separately.



#### CAUTION

**When there is equipment which generates high levels of noise, such as electromagnetic contactors, brakes, solenoids and induction motors, around the installation site, attach an appropriate surge killer to them to prevent from generating the noise.**

## CABLE CONNECTION

Strictly observe the following precautions when connecting the robot arm with the robot controller.



### WARNING

**Do not connect the primary power before connection between the robot and robot controller. Otherwise, there is a possibility of electrical shock.**



### CAUTION

- 1. Be careful not to misconnect cables when connecting the cables. Forcible connection of cables may result in damage to connectors or break in the electrical system.**
- 2. Do not step on the motor and signal cables or put objects on them. In addition, place the motor and signal cables where personnel or vehicles do not step on. If the motor and signal cables are stepped on, damage on the cables and failure in electrical system may occur.**
- 3. Separate the harness from any nearby high voltage lines (min. 1 m apart). Do not bundle or run the harnesses in parallel with other power lines. The noise generated from power lines will cause malfunctions.**

## PRIMARY POWER CONNECTION



### DANGER

Prior to connecting the primary power, confirm that the primary power supply for the controller is cut off. Display signs indicating clearly “Installation and connection in progress” on the breaker or assign a supervisor to prevent accidents caused when someone accidentally turns ON the breaker until all the connections are complete.



### WARNING

1. Connect with earth to prevent electrical noise and shock without fail.
2. Use a dedicated earth (100  $\Omega$  or less) and connect via the earth wire whose size is larger than that of the recommended cable size shown below (3.5 - 8.0 mm<sup>2</sup>).
3. Never share the earth with welder, etc. for earthing wire or minus pole (base material).
4. When using the minus pole of the weld power supply (base material), connect it to a jig or directly to base metal. Do not share the earth with the robot and the robot controller, and isolate without fail.
5. Prior to turning ON the primary power to controller, make sure the power supply is connected and all the covers are reattached properly without fail. Failure to do so may cause electrical shock.



### CAUTION

1. Prepare primary power that meets the specifications of the controller in terms of momentary power interruption, voltage fluctuation, power capacity, etc. If the power is interrupted or the voltage goes out of the controller’s specified range (above/below ratings) instantaneously, then the power monitoring circuit activates cutting off the power, and an error is returned.
2. If the primary power may emits electrical noises, set up a noise filter to reduce the noise level.
3. Provide a primary power switch (breaker) exclusively for the robot, do not share the switch with welder, etc.
4. To prevent electrical leakage, attach a breaker with anti-leak specification on the primary power switch. (Use a Time Delay Relay with sensitivity of 100 mA or more.)

## **CONNECTION WITH WELDING EQUIPMENT**

1. Check if the welding cable has no damages before connections. Use only the welding cable with no damages.
2. Use and handle the gas cylinders with caution.
3. Firmly fix the gas cylinders so as not to fall over.
4. Check if the gas hose and water-cooling torch hose have no damages on them. Use only hoses with no damages.
5. Conduct gas and water piping without gas or water leakage.
6. When using a gas flowmeter, check if it is for gas cylinders or for the factory piping, and use the appropriate flow meter.

## **ARC WELDING WORK**

1. Enclose the source of arc ray with welding screen/ plate. Arc rays can injure eyes and burn skin. Never look at the arc ray directly.
2. All operators and supervisors must wear welding glasses or masks with sufficient protection grade to protect their eyes from arc ray, spatter and slag or filler wires.
3. Use suitable welding curtain to protect the eyes of nearby persons from the arc rays.
4. Always wear welding glasses in a welding area.
5. Wear appropriate protective clothing such as leather gloves, long-sleeve shirts, leggings, leather apron, etc. in order to avoid burns caused by hot workpieces after welding and by spatter and slag.
6. Do not use flammable materials such as paint, grease, etc. near the welding area.
7. Remove flammables and combustibles well away from the welding area.
8. Always have someone watch for fire.
9. Use enough ventilation to keep hazardous fumes and gases away from the breathing zone.
10. When welding, keep your head as far away as possible from the fume to minimize the amount of fume inhaled.
11. To prevent intoxication or to eliminate possible oxygen deficiency, supply adequate ventilation by an exhaust system located as close to the work area as possible or by respiratory protection per pertinent laws and regulations, such as Industrial Safety and Health Law, Ordinance on Prevention of Hazards due to Dust.
12. Properly insulate and earth each of the required devices according to instructions for each device.
13. Electric arc welding produces electromagnetic field which may have bad influences on the pacemaker. Therefore, persons with pacemakers should not go near welding operations until they have consulted their doctor.
14. The electromagnetic noise produced in arc welding may cause malfunction of peripheral devices without noise protection.

15. Use the laser sensor in accordance with the instructions from the manufacturer when using laser welder, laser sensor and so on.
16. Incorrect usage of laser devices may result in severe injuries. Especially, take proper eye safety precautions, since there is a risk for blindness. Laser beams may also burn skin, clothing or ignite surrounding volatile substances such as alcohol.

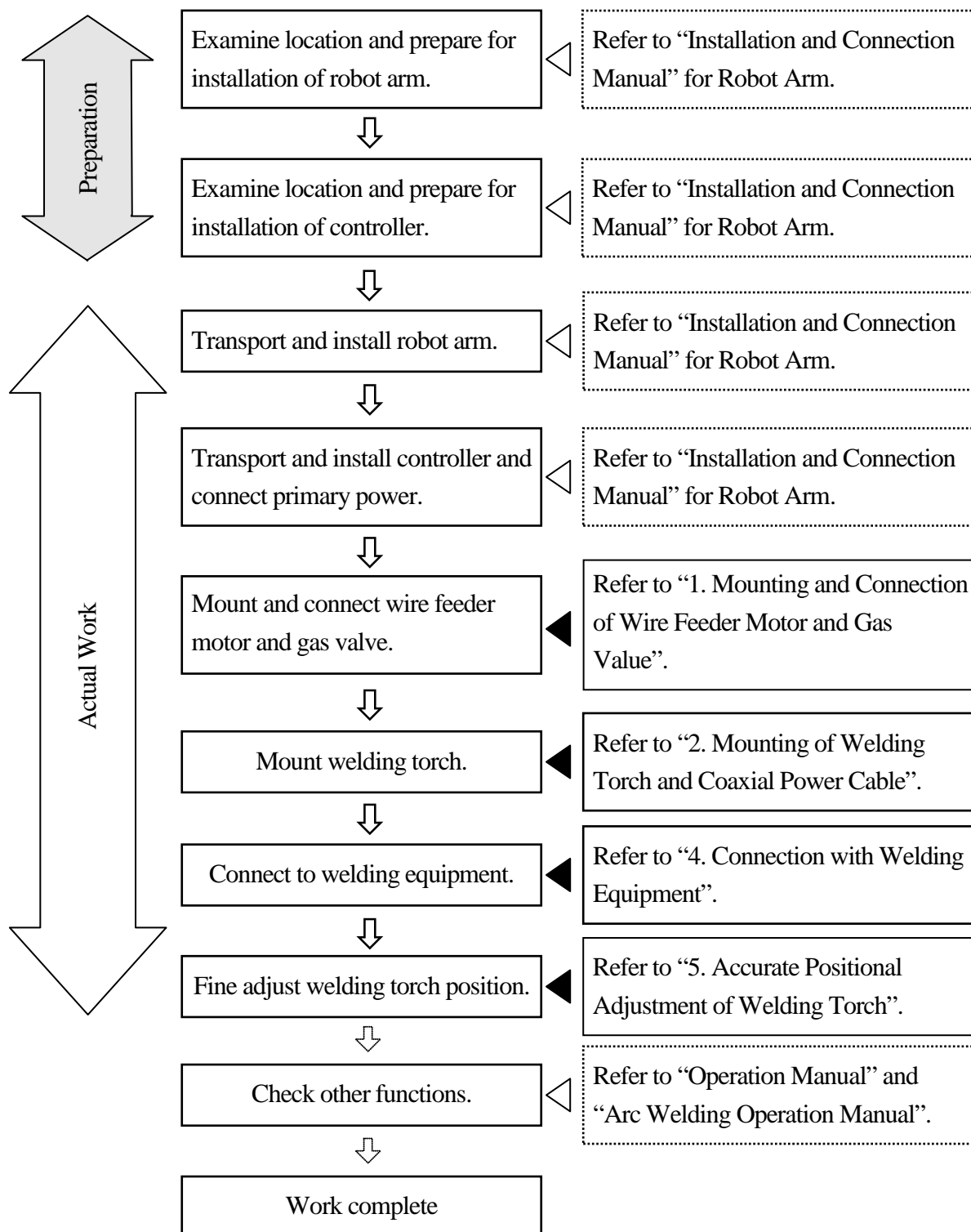


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**WORK FLOW AT INSTALLATION AND CONNECTION OF ARC WELDING ROBOT**



## 1.0 MOUNTING AND CONNECTION OF WIRE FEEDING MOTOR AND GAS VALVE



### WARNING

1. Before starting mounting of wire feeder motor and gas valve, move the robot arm to a place where the work can be done easily and turn OFF the motor power and the controller power.
2. Keep isolation between the wire feeder motor and the robot arm by bakelite board etc. without fail. Otherwise welding current might short to the robot arm due to the isolation failure.

When the welder and robot are purchased together, the wire feeder motor and gas valve are already mounted at factory shipment. For electrical wiring see Fig. 1.8 and 1.9.

### 1.1 INSTALLATION ON WALL

Installation place will vary depending on the conditions at your production facility. Carry out an appropriate installation procedure in consideration of the workpiece and other obstacles.

### 1.2 INSTALLATION ON FLOOR/SHELF

#### 1.2.1 RA06L, RA10N/L, RA20N

Follow the procedures below to mount wire feeding unit on the shoulder part of arm. The fixing brackets are separately required for mounting. Be sure to use them.

1. Referring to Fig. 1.1, mount the fixing bracket onto the shoulder part of arm.
2. Referring to Fig. 1.2, mount the wire feeding unit to the fixing bracket. For mounting, use the hexagon head bolts and washers and nuts provided with the feeding unit.
3. Referring to Fig. 1.3, connect control cable (the motor cable, the encoder cable and the voltage detection cable) connector of wire feeding unit with the specified connector.

#### [ NOTE ]

A shock sensor connector is included in the arm.

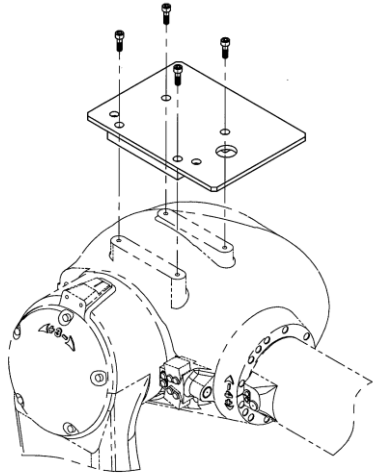


Fig. 1.1 Mounting of fixing bracket  
(Procedure 1)

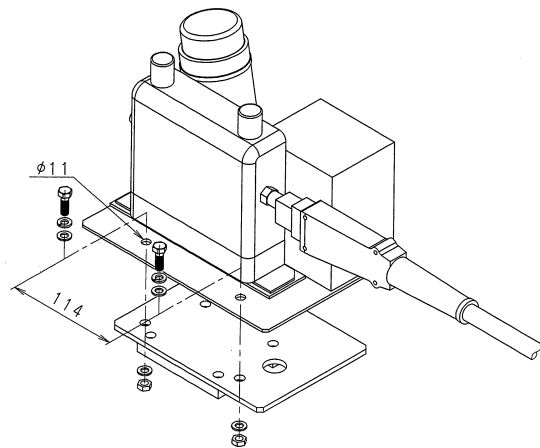


Fig. 1.2 Mounting of wire feeding unit  
(Procedure 2)

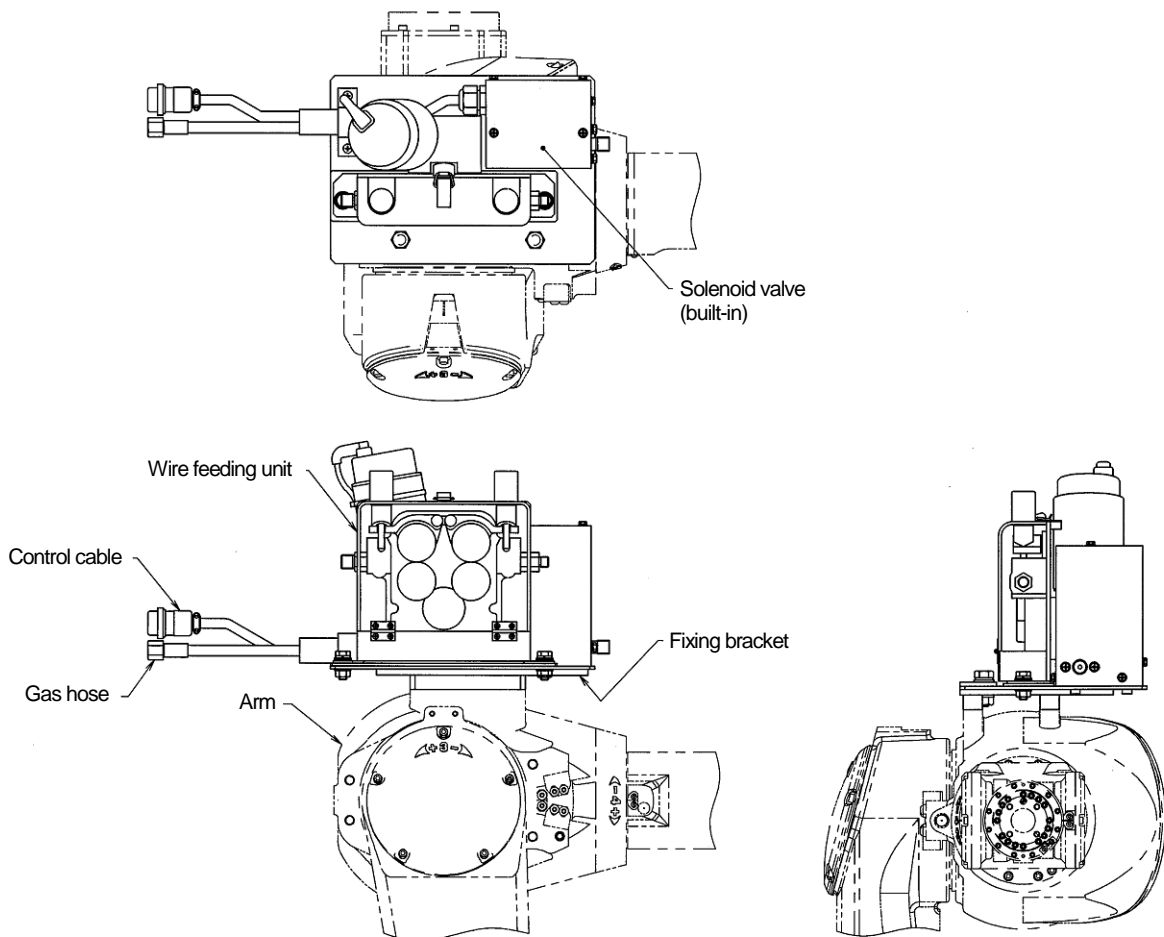


Fig. 1.3 Connection of control cable connector (Procedure 3)

### **1.2.2 RA05L**

For RA05L, the wire feeding unit cannot be mounted on the arm. Accordingly, mount it separately from the arm by yourself with consideration of workpieces and other obstacles. (See Fig. 1.2 as a reference when mounting it.)

### **1.3 CEILING INSTALLATION**

Installation place will vary depending on the conditions at your production facility. Carry out an appropriate installation procedure in consideration of the workpiece and other obstacles.

## 2.0 MOUNTING OF WELDING TORCH AND COAXIAL POWER CABLE



### WARNING

**Before mounting the welding torch, move the robot arm to a place where work can be done easily and turn OFF the motor power and the controller power of the robot controller. When replacing/mounting a welding torch that is connected to the welder, turn OFF the power to the weld machine before starting the work without fail.**

When the welder and robot are purchased together, the welding torch and the coaxial power cable are already mounted at factory shipment.

## 2.1 MOUNTING NON-KAWASAKI SHOCK SENSOR ON WRIST FLANGE

1. Mount a torch holder and welding torch whose total weight is within the load capacity of the robot, specified in separate Installation and Connection Manual for Robot Arm.
2. Keep isolation between wrist flange and welding torch without fail.

## 2.2 MOUNTING OF SHOCK SENSOR AND MOUNTING BRACKET

### 2.2.1 RA06L, RA10N

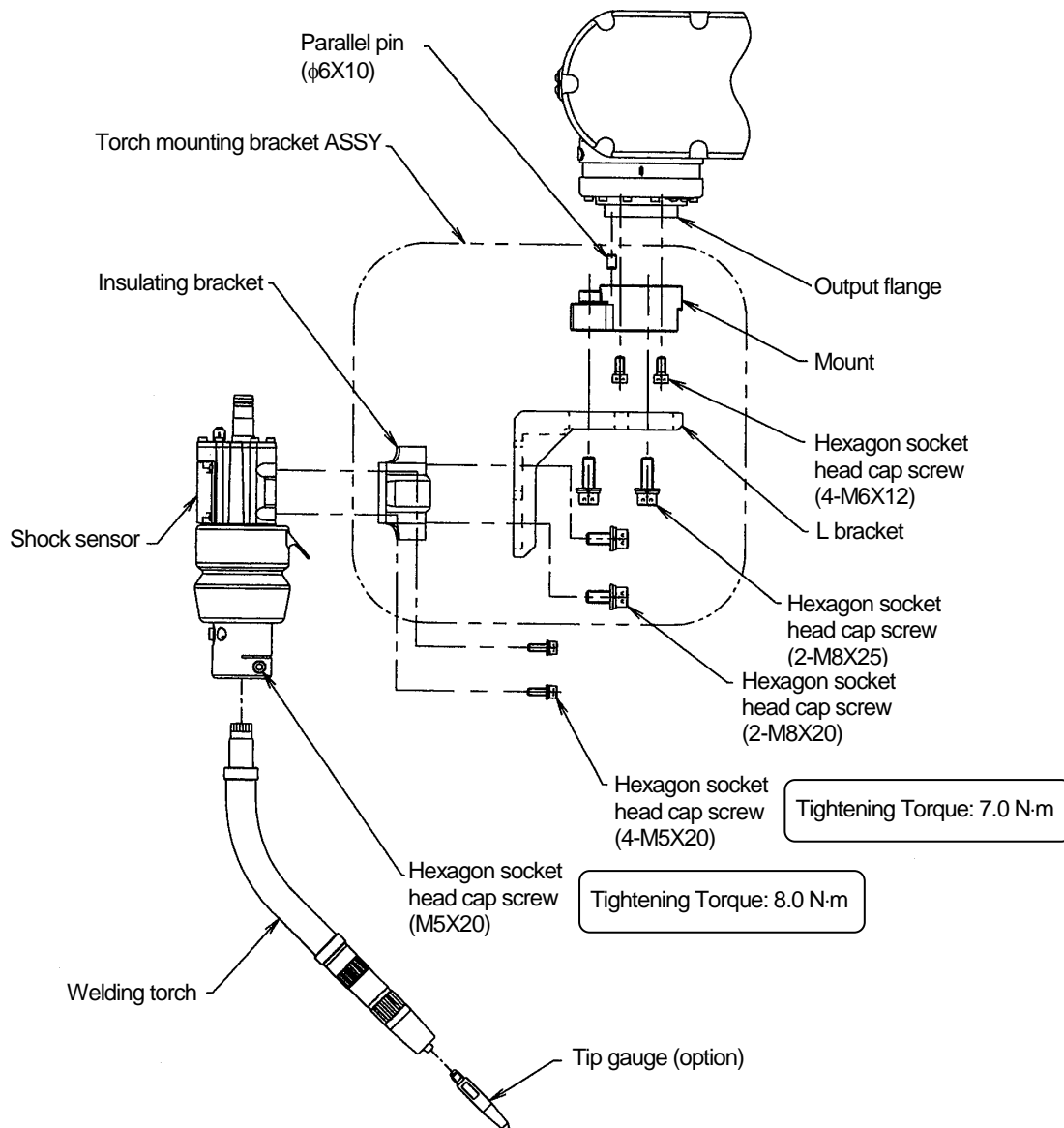


Fig. 2.1 Mounting of torch and shock sensor

1. Mount the mount onto the output flange of arm with parallel pin ( $\phi 6 \times 10$ ) and 4 hexagon socket head cap screws ( $M6 \times 12$ ).
2. Mount the L bracket to the mount with 2 hexagon socket head cap screws ( $M8 \times 25$ ).
3. Mount the insulating bracket to the L bracket with 2 hexagon socket head cap screws ( $M8 \times 20$ ).
4. Mount the shock sensor onto the insulating bracket with 4 hexagon socket head cap screws ( $M5 \times 20$ ).
5. Loosen the hexagon socket head cap screw of the shock sensor ( $M5 \times 20$ ) to insert and fix the welding torch.



### 2.2.2 RA10L, RA20N

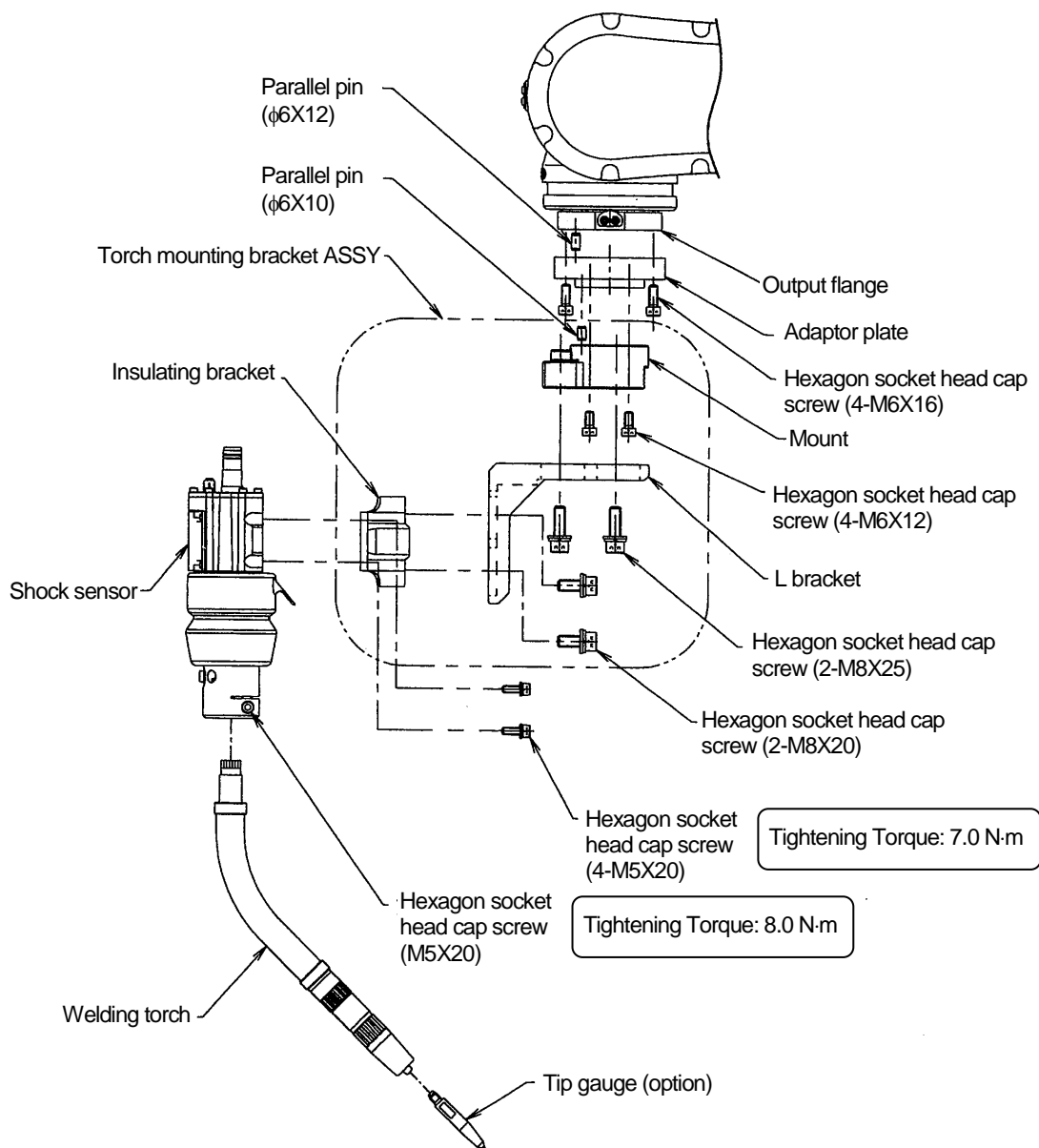


Fig. 2.2 Mounting of torch and shock sensor

1. Mount the adaptor plate onto the output flange of arm with parallel pin ( $\phi 6 \times 12$ ) and 4 hexagon socket head cap screws ( $M 6 \times 16$ ).
2. Mount the mount onto the adaptor plate with parallel pin ( $\phi 6 \times 10$ ) and 4 hexagon socket head cap screws ( $M 6 \times 12$ ).
3. Mount the L bracket to the mount with 2 hexagon socket head cap screws ( $M 8 \times 25$ ).
4. Mount the insulating bracket to the L bracket with 2 hexagon socket head cap screws ( $M 8 \times 20$ ).
5. Mount the shock sensor onto the insulating bracket with 4 hexagon socket head cap screws ( $M 5 \times 20$ ).
6. Loosen the hexagon socket head cap screw of the shock sensor ( $M 5 \times 20$ ) to insert and fix the welding torch.

### 2.2.3 RA05L

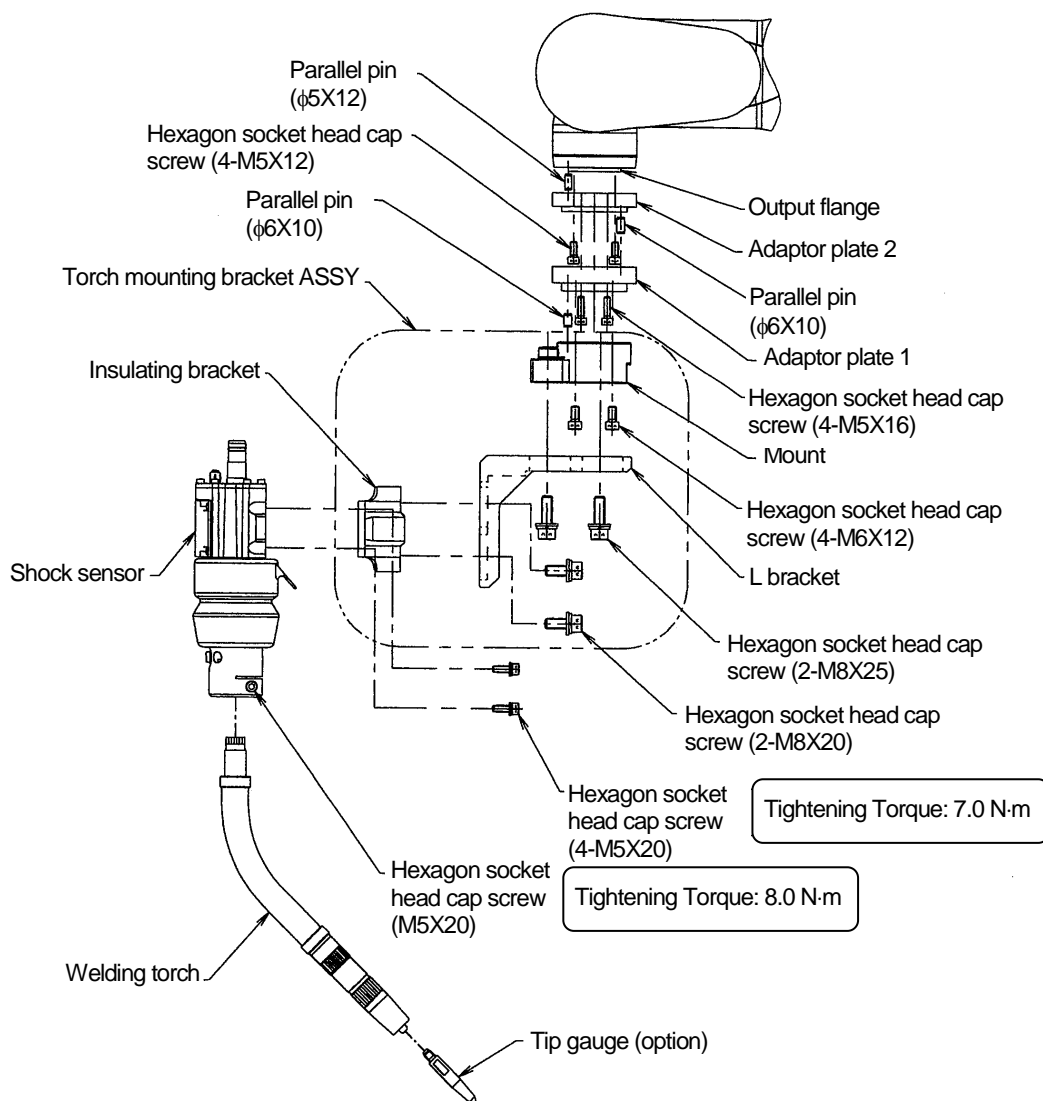


Fig. 2.3 Mounting of torch and shock sensor

1. Mount the adaptor plate 2 onto the output flange of arm with parallel pin ( $\phi 5 \times 12$ ) and 4 hexagon socket head cap screws ( $M5 \times 12$ ).
2. Mount the adaptor plate 1 onto the adaptor plate 2 with parallel pin ( $\phi 6 \times 10$ ) and 4 hexagon socket head cap screws ( $M5 \times 16$ ).
3. Mount the mount onto the adaptor plate 1 with parallel pin ( $\phi 6 \times 12$ ) and 4 hexagon socket head cap screws ( $M6 \times 12$ ).
4. Mount the L bracket to the mount with 2 hexagon socket head cap screws ( $M8 \times 25$ ).
5. Mount the insulating bracket to the L bracket with 2 hexagon socket head cap screws ( $M8 \times 20$ ).
6. Mount the shock sensor onto the insulating bracket with 4 hexagon socket head cap screws ( $M5 \times 20$ ).
7. Loosen the hexagon socket head cap screw of the shock sensor ( $M5 \times 20$ ) to insert and fix the welding torch.

## 2.3 MOUNTING OF TORCH GAUGE (OPTION)

### 2.3.1 RA06L, RA10N

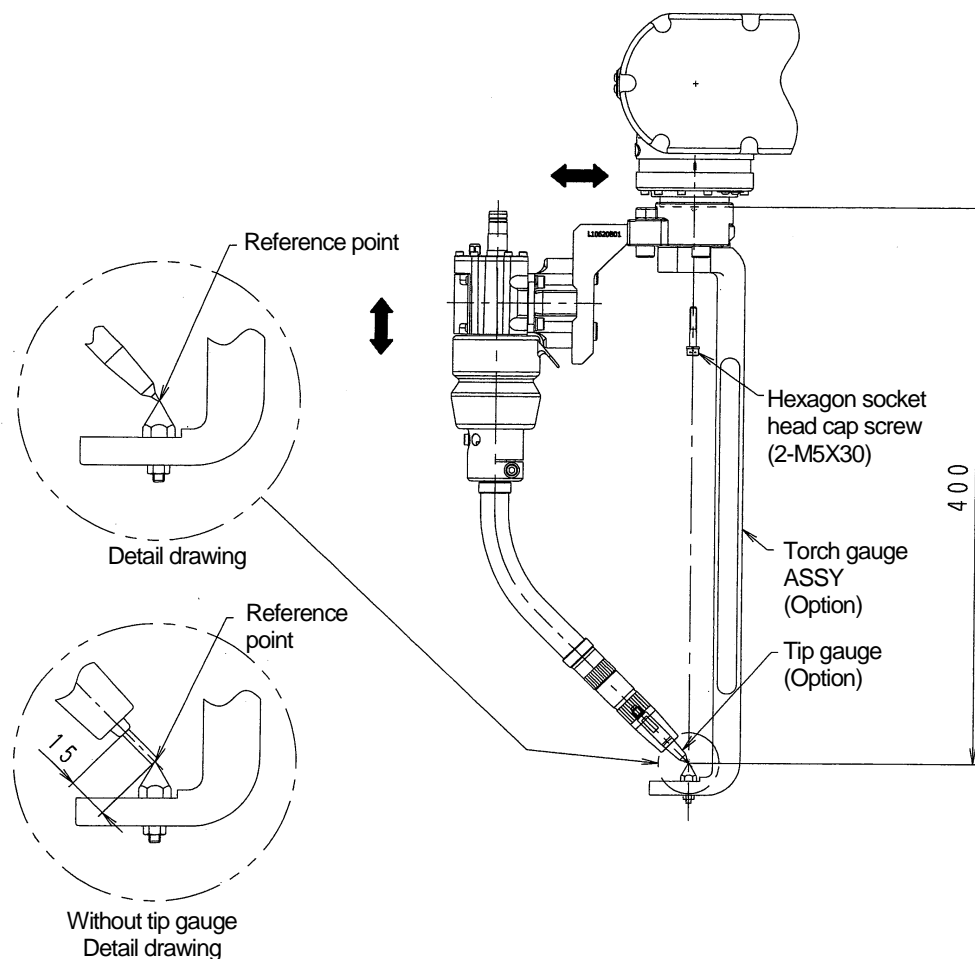


Fig. 2.4 Mounting of torch gauge

1. Remove the nozzle and the contact tip from the torch.
2. Mount the tip gauge to the torch firmly.
3. Mount the torch gauge ASSY using 2 hexagon socket head cap screws (M5×30) attached with the torch gauge ASSY.
4. Make sure that the reference point of the torch gauge coincides with the tip gauge end. If not, adjust the end position of the tip gauge so that its end coincides with the reference point of the torch gauge. (Refer to 2.4 for torch adjustment method.)

[ NOTE ]

When the tip gauge is not used, adjust the torch by cutting wire to a specified length, etc.

2.3.2 RA10L, RA20N

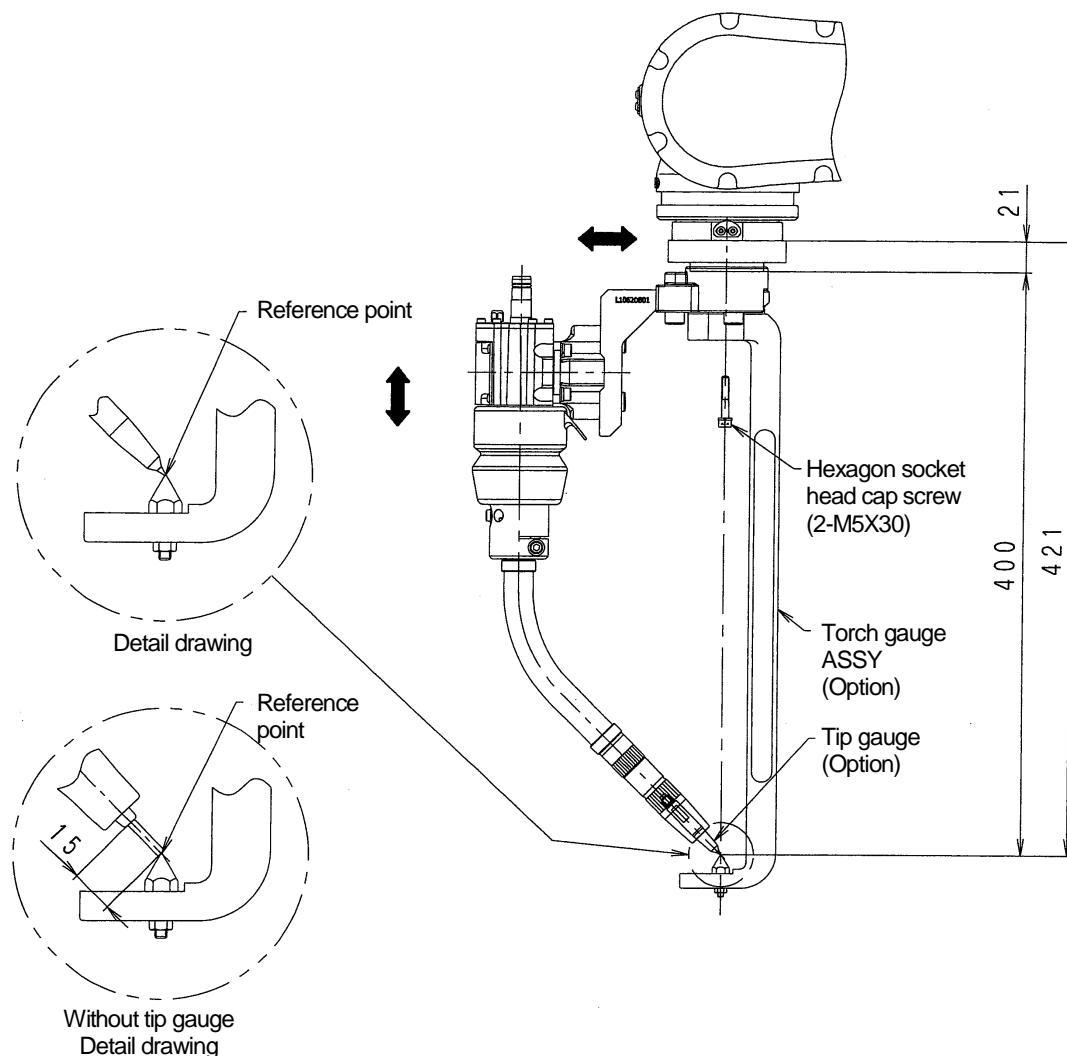


Fig. 2.5 Mounting of torch gauge

1. Remove the nozzle and the contact tip from the torch.
2. Mount the tip gauge to the torch firmly.
3. Mount the torch gauge ASSY using 2 hexagon socket head cap screws (M5×30) attached with the torch gauge ASSY.
4. Make sure that the reference point of the torch gauge coincides with the tip gauge end. If not, adjust the end position of the tip gauge so that its end coincides with the reference point of the torch gauge. (Refer to 2.4 for torch adjustment method.)

[ NOTE ]

When the tip gauge is not used, adjust the torch by cutting wire to a specified length, etc.

### 2.3.3 RA05L

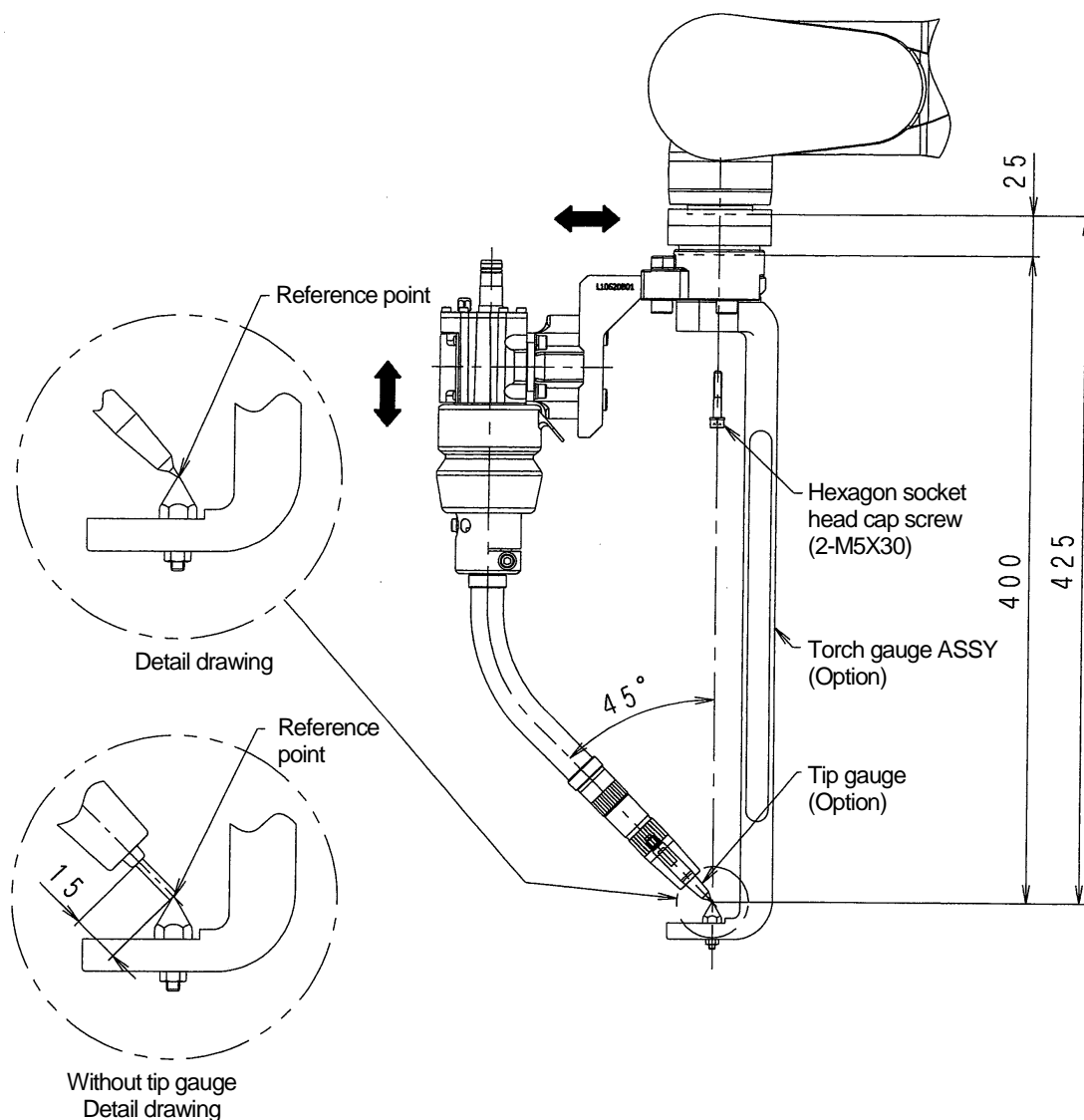


Fig. 2.6 Mounting of torch gauge

1. Remove the nozzle and the contact tip from the torch.
2. Mount the tip gauge to the torch firmly.
3. Mount the torch gauge ASSY using 2 hexagon socket head cap screws (M5×30) attached with the torch gauge ASSY.
4. Make sure that the reference point of the torch gauge coincides with the tip gauge end. If not, adjust the end position of the tip gauge so that its end coincides with the reference point of the torch gauge. (Refer to 2.4 for torch adjustment method.)

**[ NOTE ]**

When the tip gauge is not used, adjust the torch by cutting wire to a specified length, etc.

## 2.4 TORCH ADJUSTMENT METHOD

### 2.4.1 RA06L, RA10N/L, RA20N

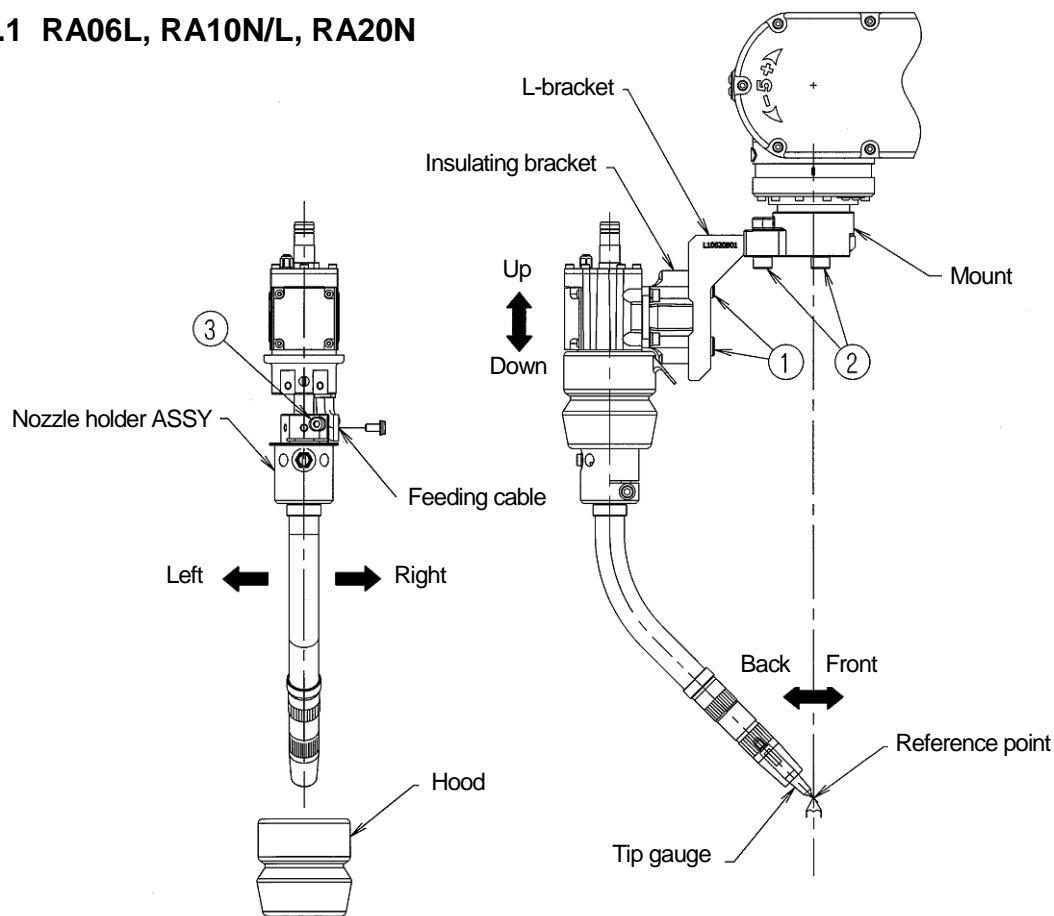


Fig. 2.7 Torch adjustment method

1. If the torch end deviates in vertical direction, loosen 2 hexagon socket head cap screws ① (M8×20) that fix the insulating bracket onto the L bracket. Correct the position, moving the torch end in the direction that the torch end deviates (upward or downward), and then fix it firmly by tightening the hexagon socket head cap screws.
2. If the torch end deviates in front-back direction, loosen 2 hexagon socket head cap screws ② that fix the mount onto the L bracket (M8×25). Correct the position, moving the torch end in the direction in which the torch end deviates (backward or forward), and then fix it firmly by tightening the hexagon socket head cap screws.
3. If the torch end deviates in horizontal direction, adjust in the following procedure referring to the Fig. 2.9.
  - (1) Remove the hood.
  - (2) Remove the hex. cap screw (M5×12) fixing feeding cable connected to the nozzle holder.
  - (3) Loosen the hex. cap screw ③ and rotate the holder in the proper direction so that the deviation is eliminated.
  - (4) After fixing the nozzle holder and the feeding cable firmly remount the hood.

### 2.4.2 RA05L

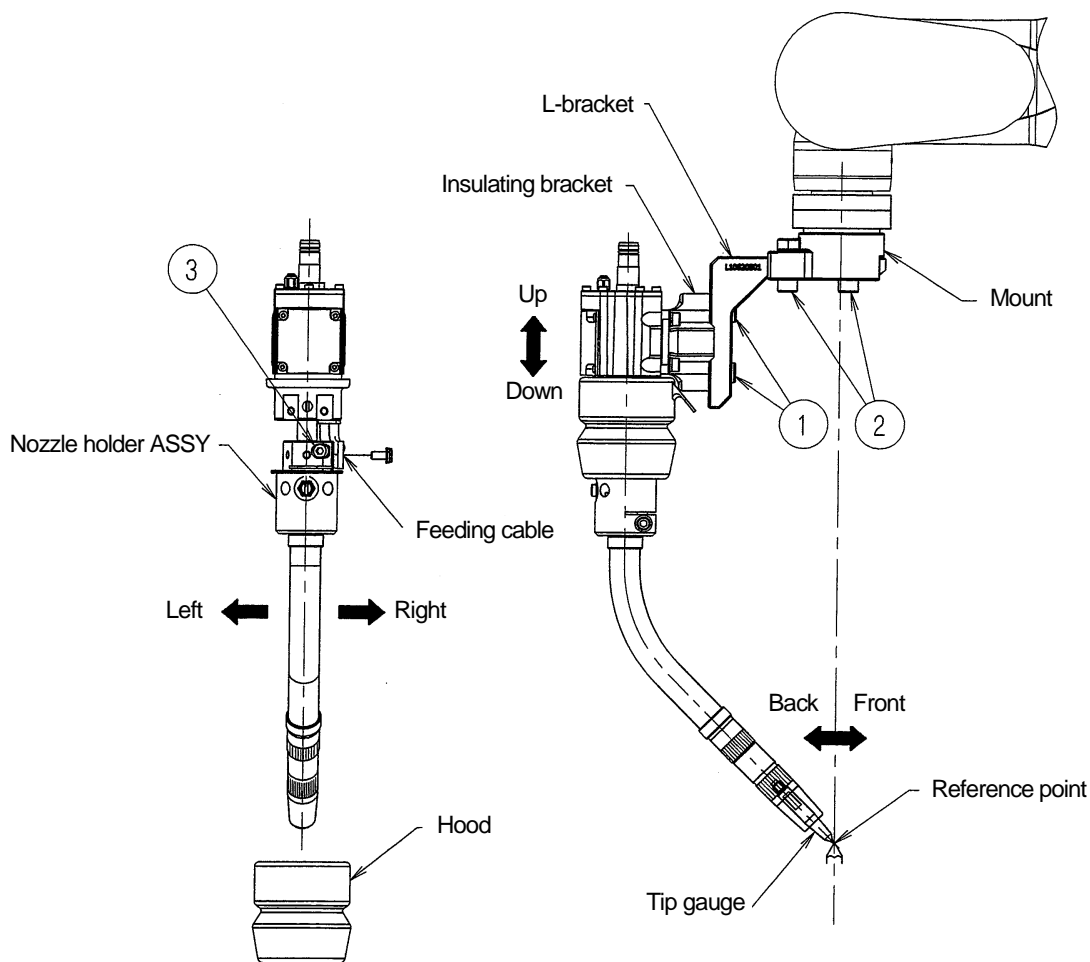


Fig. 2.8 Torch adjustment method

1. If the torch end deviates in vertical direction, loosen 2 hexagon socket head cap screws ① (M8×20) that fix the insulating bracket onto the L bracket. Correct the position, moving the torch end in the direction that the torch end deviates (upward or downward), and then fix it firmly by tightening the hexagon socket head cap screws.
2. If the torch end deviates in front-back direction, loosen 2 hexagon socket head cap screws ② that fix the mount onto the L bracket (M8×25). Correct the position, moving the torch end in the direction in which the torch end deviates (backward or forward), and then fix it firmly by tightening the hexagon socket head cap screws.
3. If the torch end deviates in horizontal direction, adjust in the following procedure referring to the Fig. 2.9.
  - (1) Remove the hood.
  - (2) Remove the hex. cap screw (M5×12).fixing feeding cable connected to the nozzle holder.
  - (3) Loosen the hex. cap screw ③ and rotate the holder in the proper direction so that the deviation is eliminated.

(4) After fixing the nozzle holder and the feeding cable firmly remount the hood.

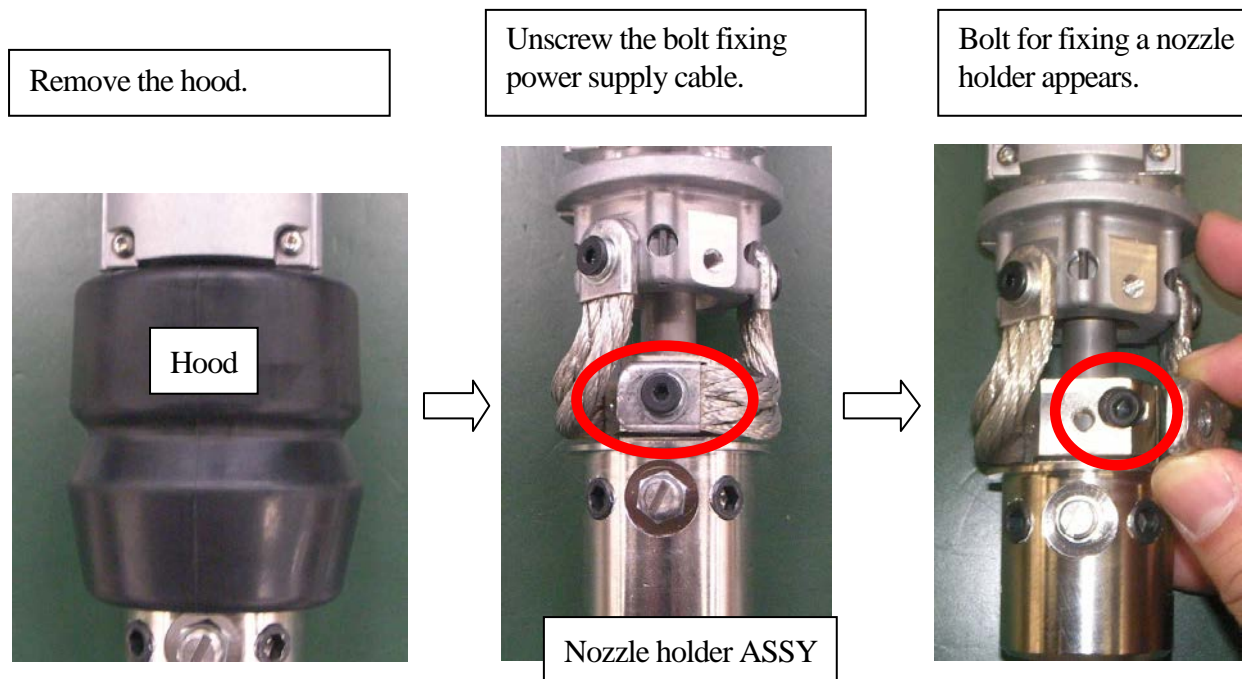


Fig 2.9 Adjustment method of torch (right/left direction)



## 2.5 TYPE OF COAXIAL POWER CABLES

The coaxial power cable is to lead the wire, shield gas and shock sensor cable from the wire feeding unit to the torch. Refer to the table below to select the coaxial power cable according to the arm.

Table: Types of coaxial power cables

Applicable arm	Cable length
RA05L	*
RA06L	1.3 m
RA10N	1.1 m
RA10L	1.4 m
RA20N	1.2 m

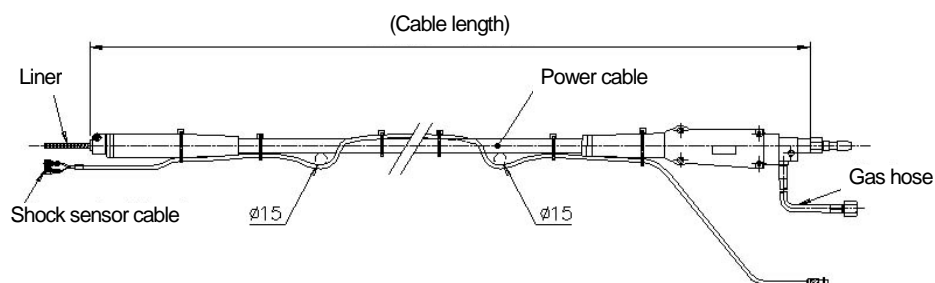


Fig. 2.10 Outline drawing of the coaxial power cable

**NOTE\*** For RA05L, decide the length of coaxial power cables by yourself because the wire feeding unit is placed separately.

## 2.6 CONNECTION OF COAXIAL POWER CABLE

### 2.6.1 RA06L, RA10N/L, RA20N

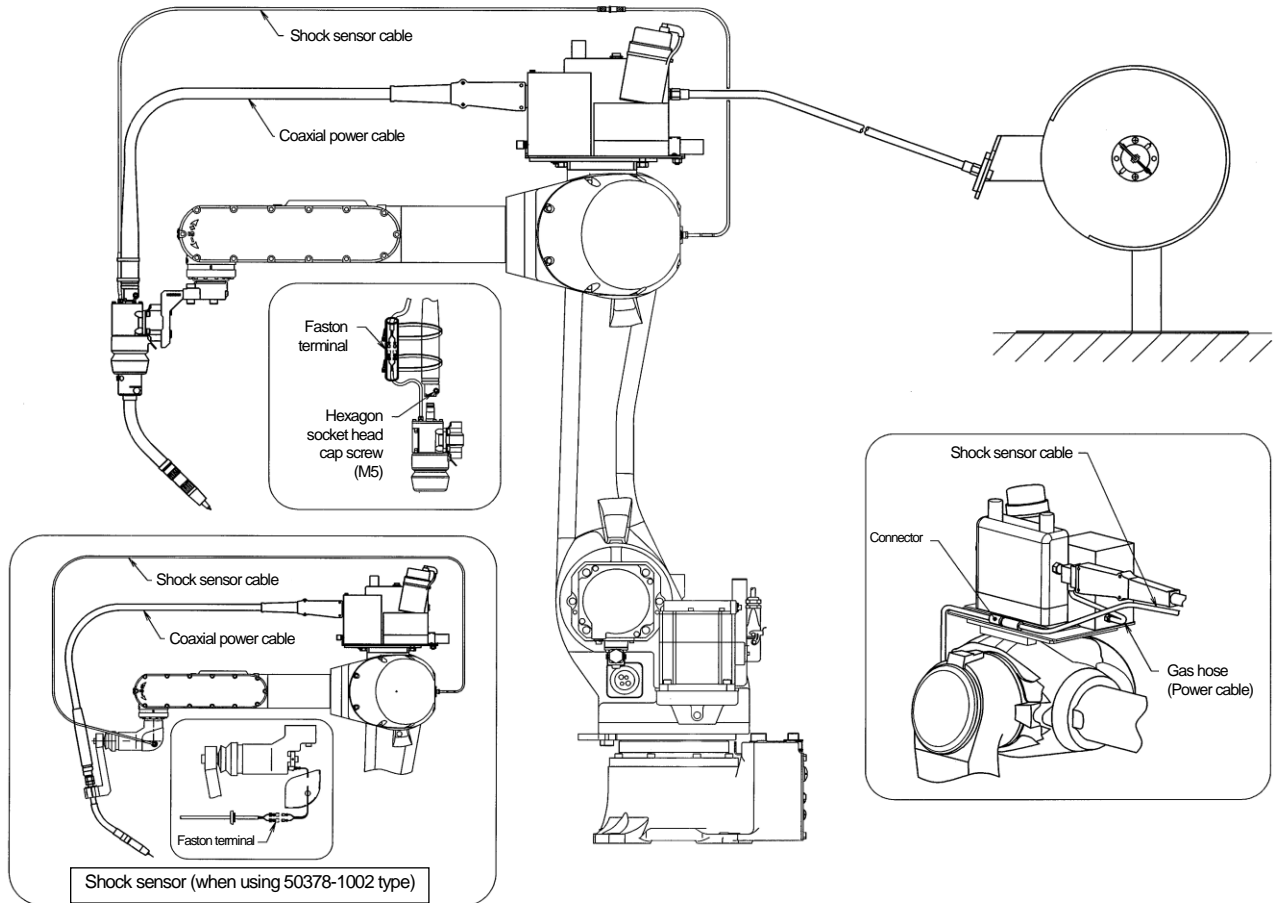


Fig. 2.11 Connection of the coaxial power cable

Protect the FASTON terminal of the shock sensor cable with the silicon tube supplied with the coaxial power cable, and then fix it to the coaxial power cable with the tying band.

### 2.6.2 RA05L

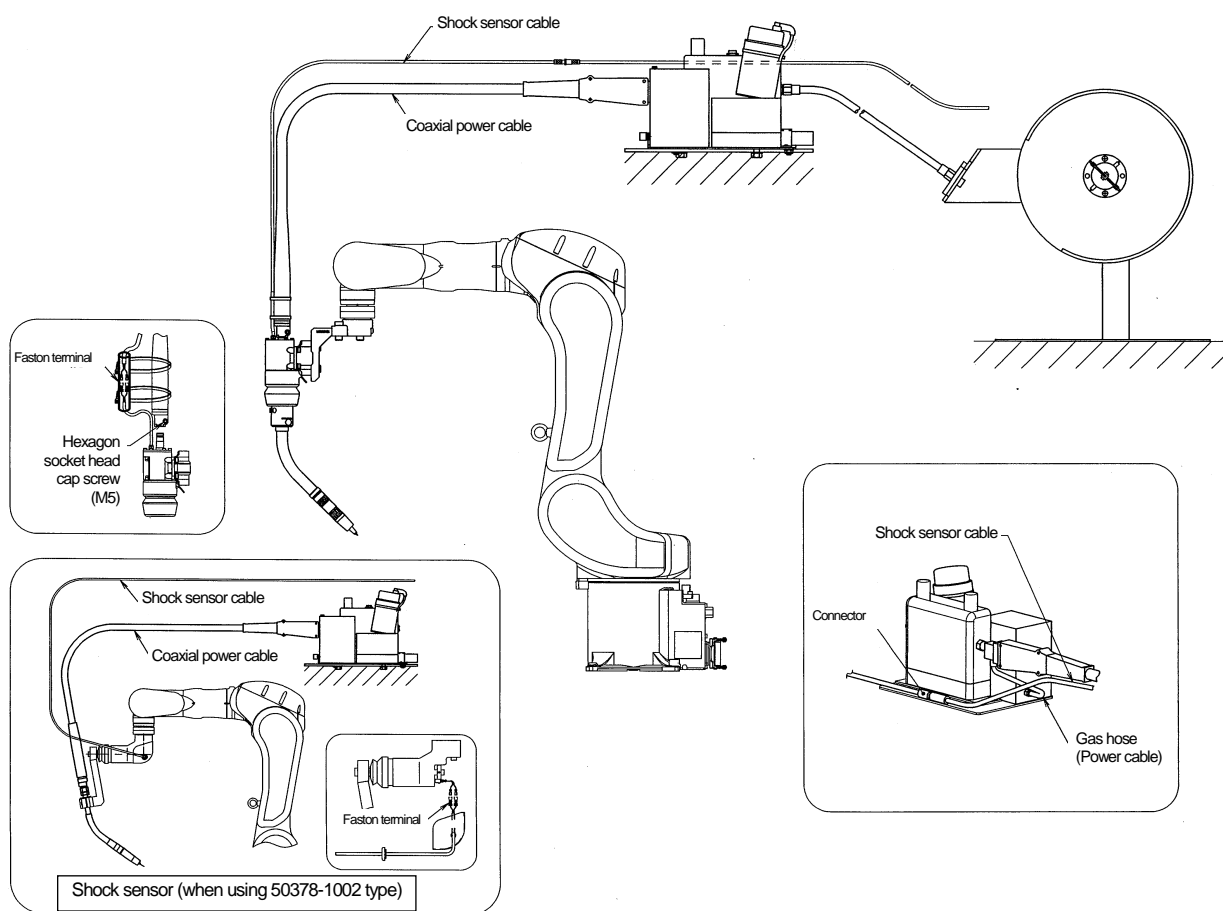


Fig. 2.12 Connection of the coaxial power cable

Protect the FASTON terminal of the shock sensor cable with the silicon tube supplied with the coaxial power cable, and then fix it to the coaxial power cable with the tying band.

## 2.7 CUTTING THE LINER

Cut the liner according to the length of each torch, referring to Fig. 2.13, Fig. 2.14, Table 2.1 and Table 2.1. Rasp the edge of the liner's cut section to eliminate burrs, etc. Also, take enough care not to bend a liner or burr the hole when cutting.

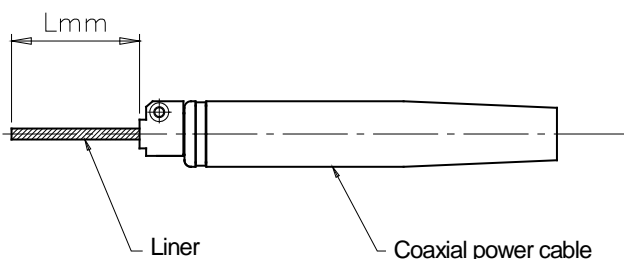


Fig.2.13 Cut length of liner from coaxial power cable

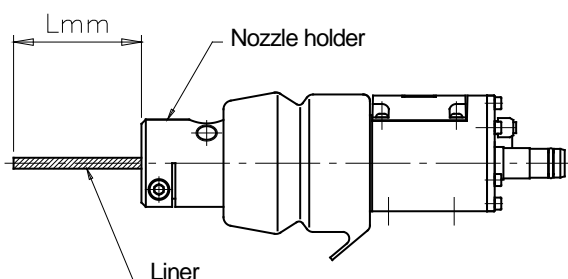


Fig.2.14 Cut length of liner from nozzle holder

Table 2.1 Cut length of liner from coaxial power cable (rough)

DAIHEN torch (model)	L (mm)
RT3500S	291
RT3500H	360
RT3500L	331
RT5000S	274
RT5000H	343
RT5000L	314
RTW5000S	288
RTW5000H	356
RTW5000L	338
RZ3500S	207
RZ3500H	277
RZ3500L	263

Table 2.2 Cut length of liner from nozzle holder (rough)

DAIHEN torch (model)	L (mm)
RT3500S	128
RT3500H	197
RT3500L	168
RT5000S	111
RT5000H	180
RT5000L	151
RTW5000S	124
RTW5000H	193
RTW5000L	174
RZ3500S	44
RZ3500H	115
RZ3500L	100

## 2.8 LINER CLAMP FUNCTION

A liner clamp is equipped with the nozzle holder of each shock sensor.

During welding, weld wire may become floppy and it causes unstable wire feeding depending on clearance between the sensor and the liner in the coaxial power cable. This problem will result in faulty weld arc start or fluctuations in the protrusion length of weld wire.

The liner clamp unit has the effect of reducing the behavior of weld wire by binding the coil liner.

1. Loosen the lock nut, and then thoroughly pull out the clamp screw.
2. Insert the coaxial power cable.
3. Gradually turn the clamp screw until it hits against the liner, and then make it 1/4 turns.
4. Clamp the liner with the lock nut.

### [ NOTE ]

1. Turning the clamp screw excessively will damage the liner and disables weld wire feeding.
2. To remove the coaxial power cable or the liner, unclamp the liner clamp first.

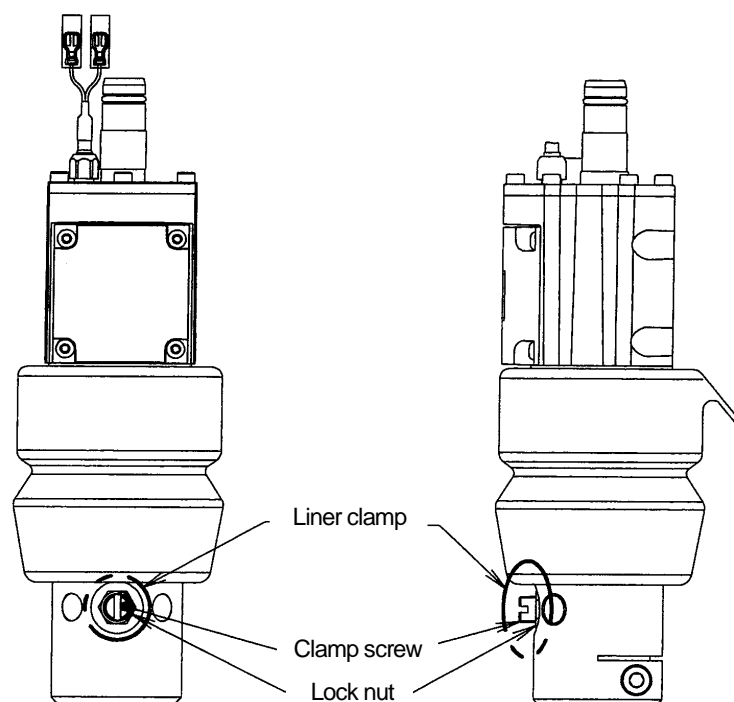


Fig.2.15 Liner clamp

### 3.0 EARTHING METHOD



#### WARNING

1. **Never share the earth among the robot controller, robot arm, welder, other equipment and etc.**
2. **For the controller and robot arm, use a dedicated earth (100  $\Omega$  or less) as the earth line shown below.**
3. **If earthing and insulation of the controller and the robot arm are insufficient, malfunction caused by noise from earth lines, breakage or electrical shock may occur. Accordingly, strictly observe below. In addition, make sure that the controller and the robot are connected with dedicated earth lines and check that they are isolated from other equipment and devices via a circuit tester, etc.**

Robot controller : 3.5 mm<sup>2</sup> (AWG #12)

Robot arm : 3.5 mm<sup>2</sup> (AWG #12)

For the multi axes robot, use an earth line whose size is larger than that of the power supply line.

Isolate the wire feeding unit and welding torch from the robot arm using Bakelite etc. (Refer to Safety, page 3.)

Earthing is extremely important to prevent noise and electrical shock, etc. Connect the earthing wire by the following method.

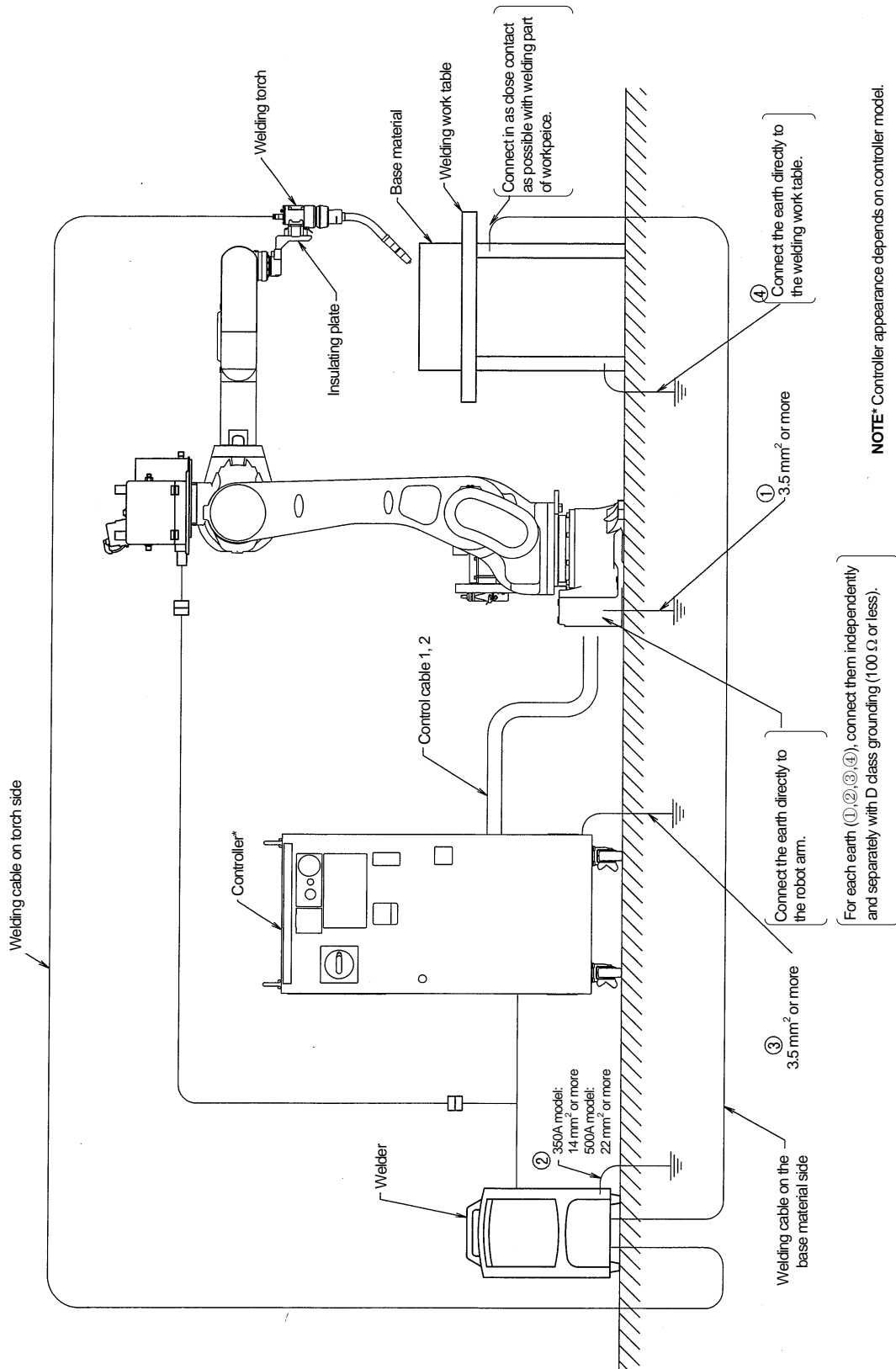


Fig.3.1 For RA05L, RA06L, RA10N/L and RA20N

## 4.0 CONNECTION WITH WELDING EQUIPMENT



### WARNING

- 1. Before connecting the robot arm with welding equipment, move the robot arm to a place where the work can be done easily. Then turn OFF the motor power and the controller power.**
- 2. Before connecting the robot arm with welding equipment, turn OFF the welder power supply without fail.**

An example of connection to an arc welder, etc. is shown in the figure on the next page (In this case, an air-cooled torch). For details of handling and connection of power cables, etc. to the welder, refer to its instruction manual.

1. Connect the welder interface board in the controller (Refer to Appendix 2.0 Welder Interface Board.) to the welder via the I/F cable.
2. For CO<sub>2</sub> welding, a heater and gas flowmeter are normally connected to the gas cylinder. Non-heater type gas cylinder is also available. If a factory piping is used instead of cylinders, connect a flowmeter designed for factory piping.
3. Connect welding cable (earth) with the welding work table.
4. For the wire feeding unit, a reel type machine is shown in the figure. However, when a pack is used, connect the wire feeding unit with the pail pack.



When DAIHEN welding power source (DM-350) is used

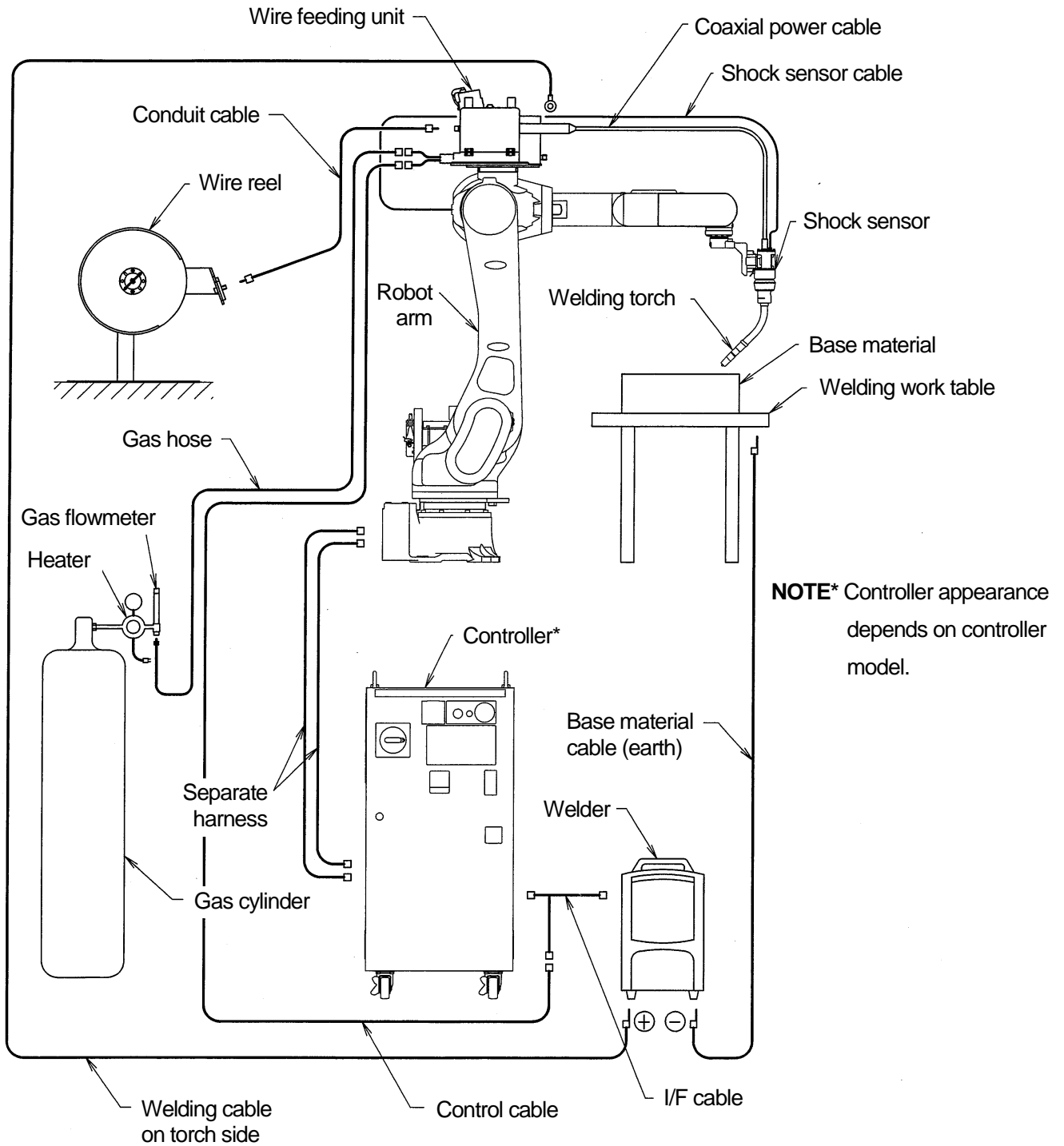


Fig.4.1 For RA06L, RA10N/L and RA20N

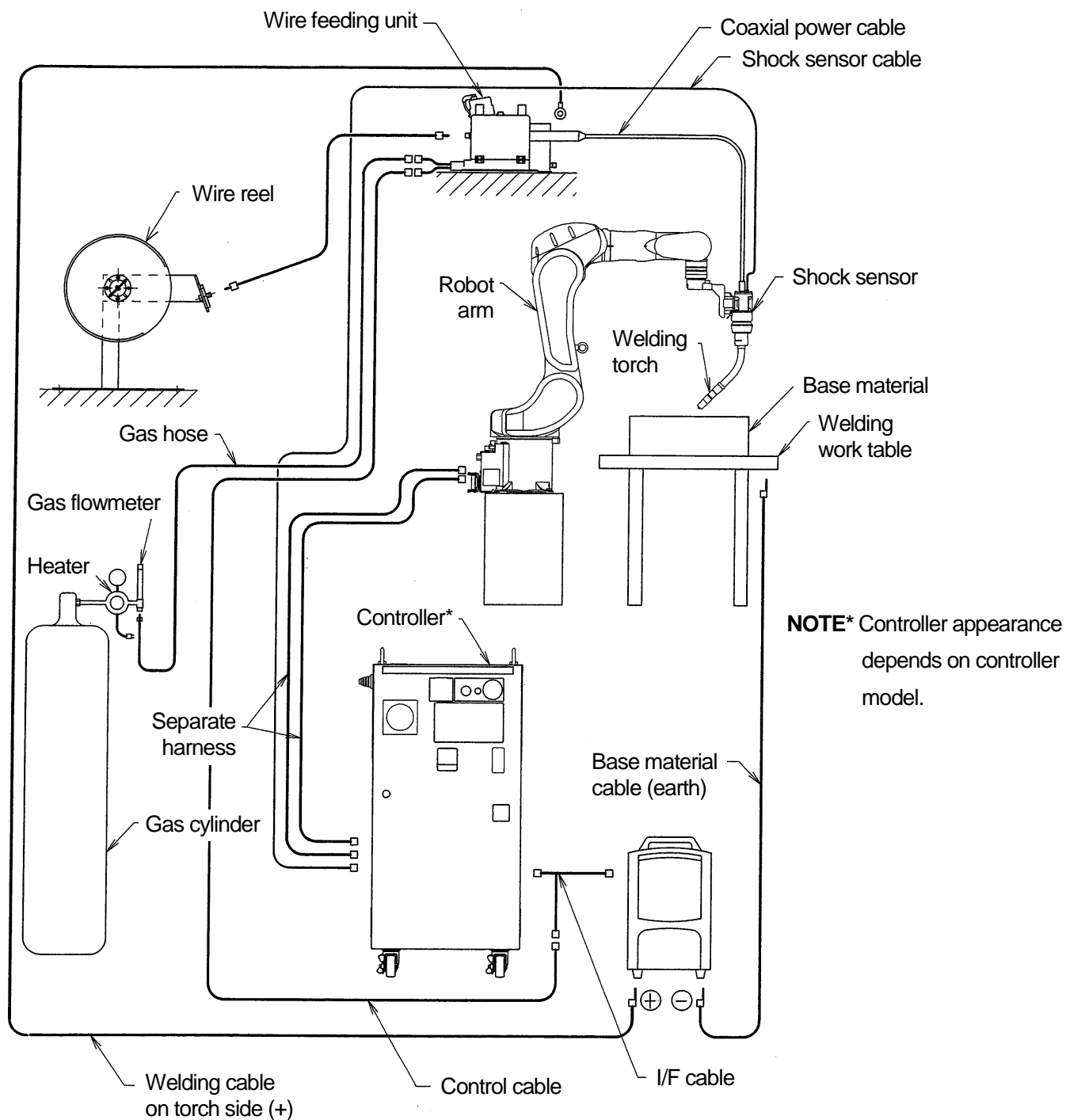


Fig.4.2 For RA05L

## 5.0 ACCURATE POSITIONAL REGISTRATION AND ADJUSTMENT OF WELDING TORCH

When the welder and robot are purchased together, the accurate positional adjustment of welding torch and the registration of the torch dimensions to controller are complete at factory shipment.

This section describes the method for adjusting a torch when mounting and registering a torch. For the countermeasure to deformation and replacement of a torch, refer to Appendix 3.0.

### 5.1 REGISTRATION METHOD OF TORCH DIMENSIONS TO CONTROLLER

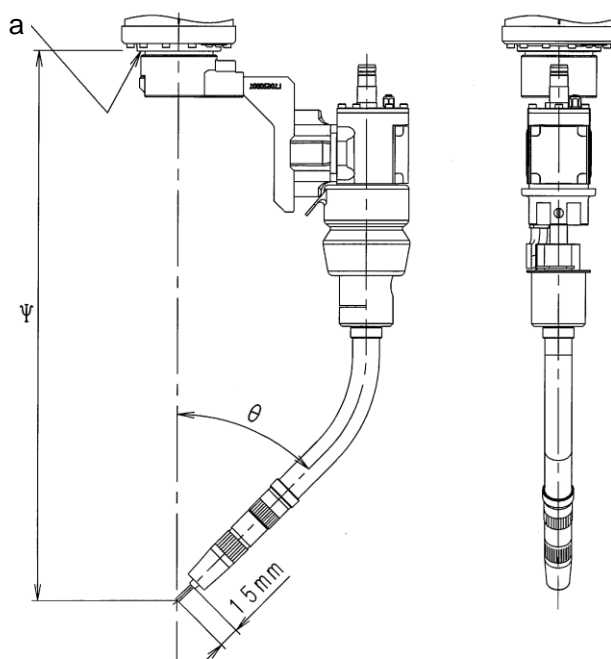


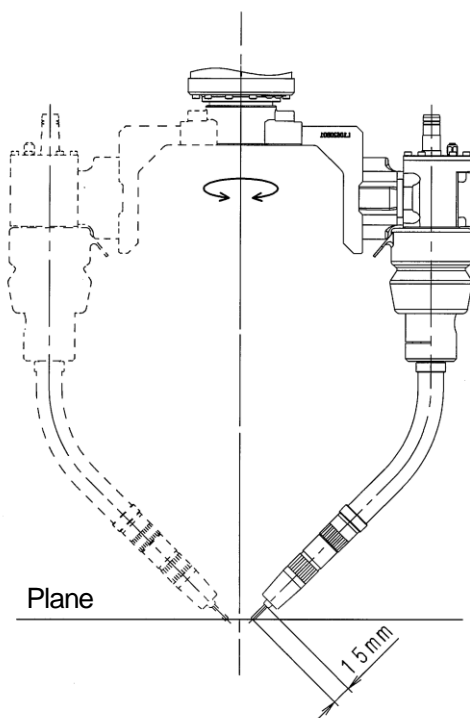
Fig. 5.1 Torch that enables the wire tip to be set on the rotation center of JT6

There are two setting methods depending on the torch shape.

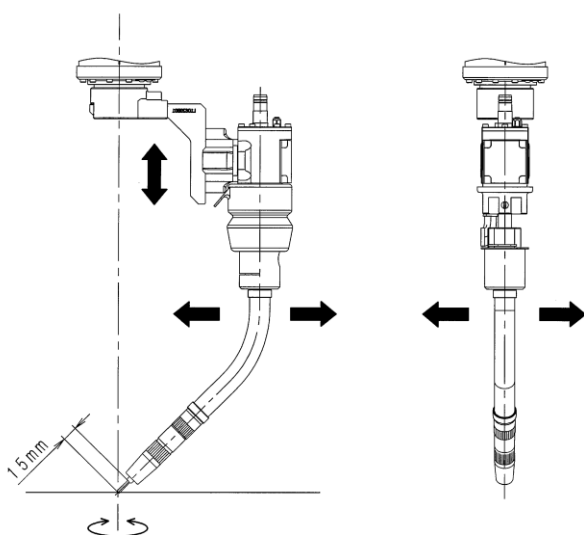
1. Torch that enables the wire tip to be set on the rotation center of JT6  
Register  $\psi$ -length (mm) and  $\theta$ -angle (degree) shown in Fig. 5.1 and wire extension length at teaching for the torch shown in Fig. 5.1. For details on registration procedures, refer to Aux. 1405 Arc Torch Dimension, in the separate Arc Welding Operation Manual.
2. Torch that disables the wire tip to be set on the rotation center of JT6  
Set the tool dimensions via Automatic Tool Registration for the torch. For details on registration procedures, refer to 10. Automatic Tool Registration, in the separate Operation Manual.

## 5.2 ADJUSTMENT PROCEDURES IN THE MOUNTING POSITION

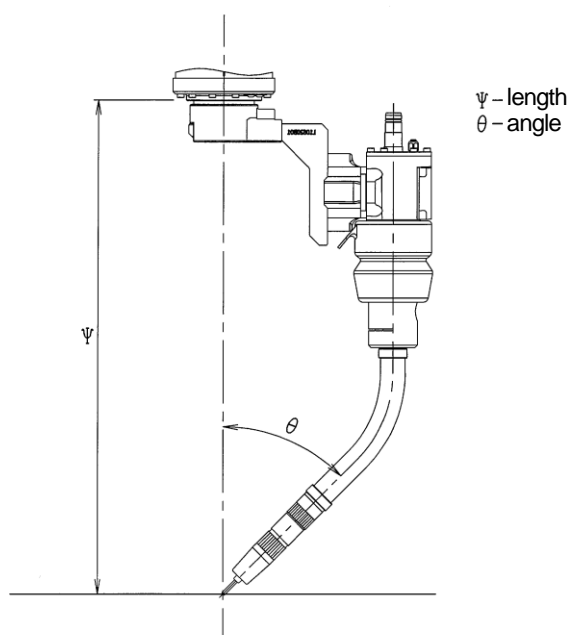
This section describes the adjustment procedure of mounting position of the torch that enables the wire tip to be set on the rotation center of JT6.



1. First, set the wire extension length to 15 mm. Attach the welding torch so that the wire tip is on a plane surface. When the torch end point is aligned with the reference point on the torch gauge (option), items 1, 2, 9-11 can be omitted.



2. Rotate JT6 to check the wire tip motion. Wire tip draws a circle if it deviates from the rotation center of JT6. In this case, adjust the torch holder so that the wire tip is on the center of the circle. Refer to 2.4 for the adjusting method.



3. Measure the approximate tool dimensions and angle of the torch by referring to the mechanical drawings or by using a scale and protractor.

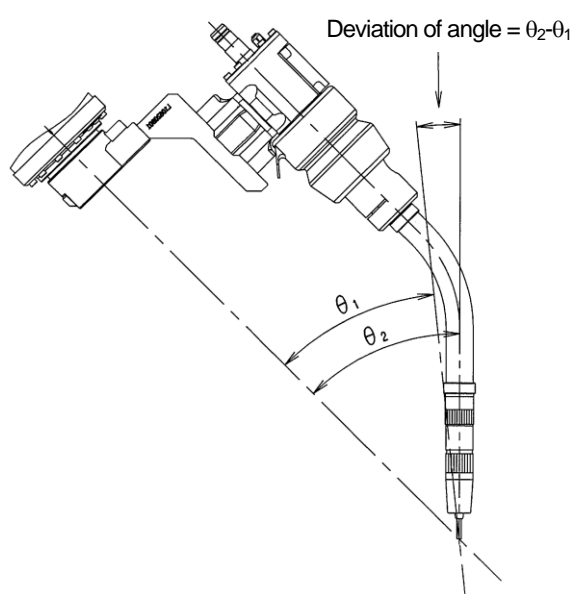
4. Register the following values to arc torch dimension of auxiliary function.

Length :  $\psi$ -length (mm)  
Angle :  $\theta$ -angle (degree)  
Wire extension : 15 (mm)

In the torch gauge (option) alignment,  $\psi$  is as follows and items 9-11 can be omitted.

RA05L: 425 mm  
RA06L, RA10N: 400 mm  
RA10L, RA20N: 421 mm

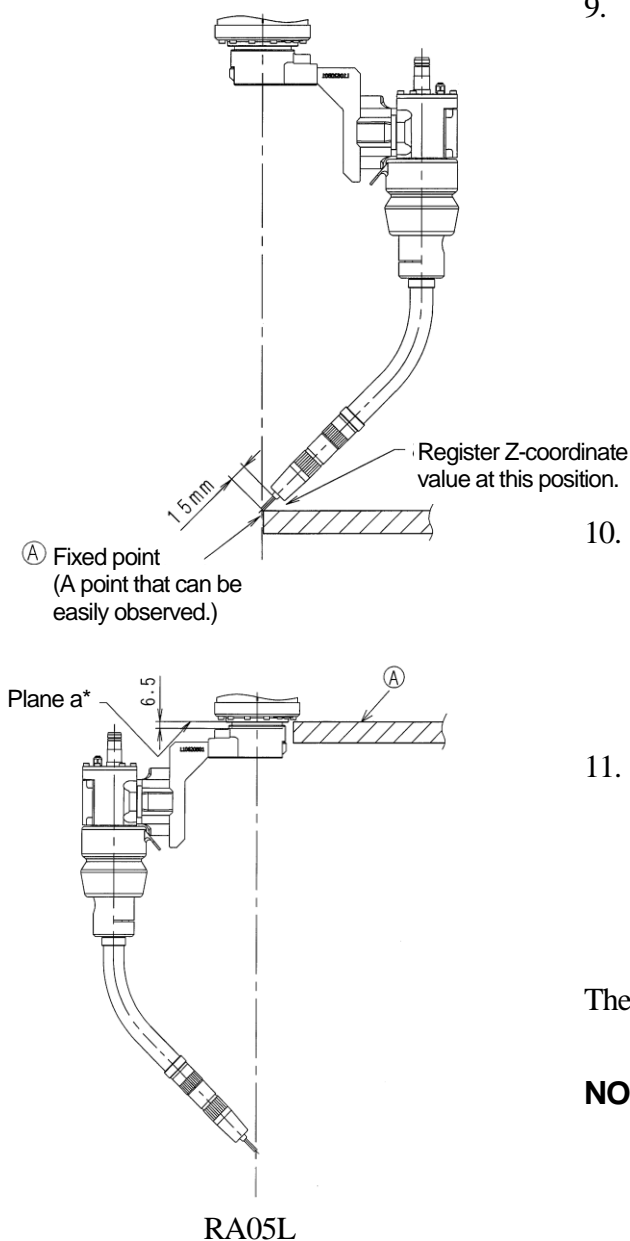
5. Move the robot axes manually so the welding torch faces vertically downward.
6. Execute align-operation using teach pendant. (Refer to Alignment Operation in the separate Arc Welding Operation Manual.)



7. If registered torch angle in 4 above is not accurate, the registered torch angle ( $\theta_1$ ) deviates from the actual torch angle ( $\theta_2$ ) when executing align operation in 6 above. (See left figure.) In this case, measure the deviation visually and calculate the new torch angle, then re-register the new torch angle.

e.g:  $\theta_1=30^\circ$ , Deviation of angle= $2^\circ$   
 $30^\circ+2^\circ(\text{Deviation})=32^\circ$  (new torch angle)

8. Execute align-operation via teach pendant again, and check for any angle deviation. Repeat steps 7 and 8 above until the torch angle is set vertically downward, then register an accurate tool angle for  $\theta$ .



9. Measure the tool dimensions.  
First, set the wrist flange face horizontal. Then move the tool end to a fixed reference point in space via teach pendant and note the Z-coordinate value ( $Z_1$ ) on the base coordinate system at that position.

10. Move the wrist flange face to the same fixed point used in 9 and note the Z-coordinate value ( $Z_2$ ) on the base coordinate system via teach pendant.

11. Calculate tool dimension from  $Z_1$  and  $Z_2$  above using the following formula:

$$\text{Tool dimension} = Z_1 - Z_2 + 19 \text{ (RA05L)}$$

$$\text{Tool dimension} = Z_1 - Z_2 - 7 \text{ (RA06L/10N)}$$

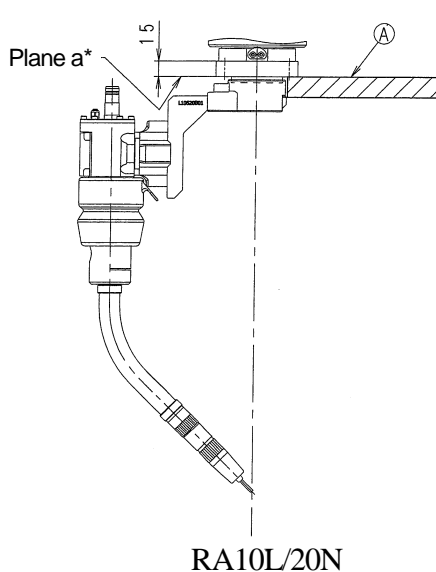
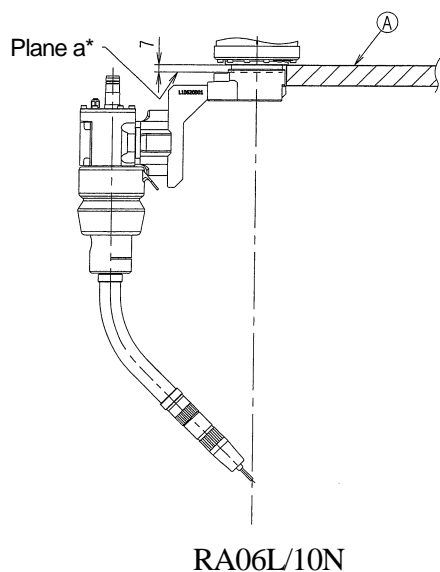
$$\text{Tool dimension} = Z_1 - Z_2 + 15 \text{ (RA10L/20N)}$$

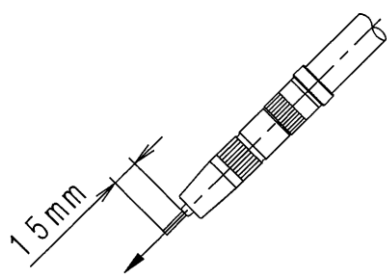
Then register the tool dimension calculated above.

**NOTE\*** Plane a :

Plane that contacts with the fixed point

Ⓐ.



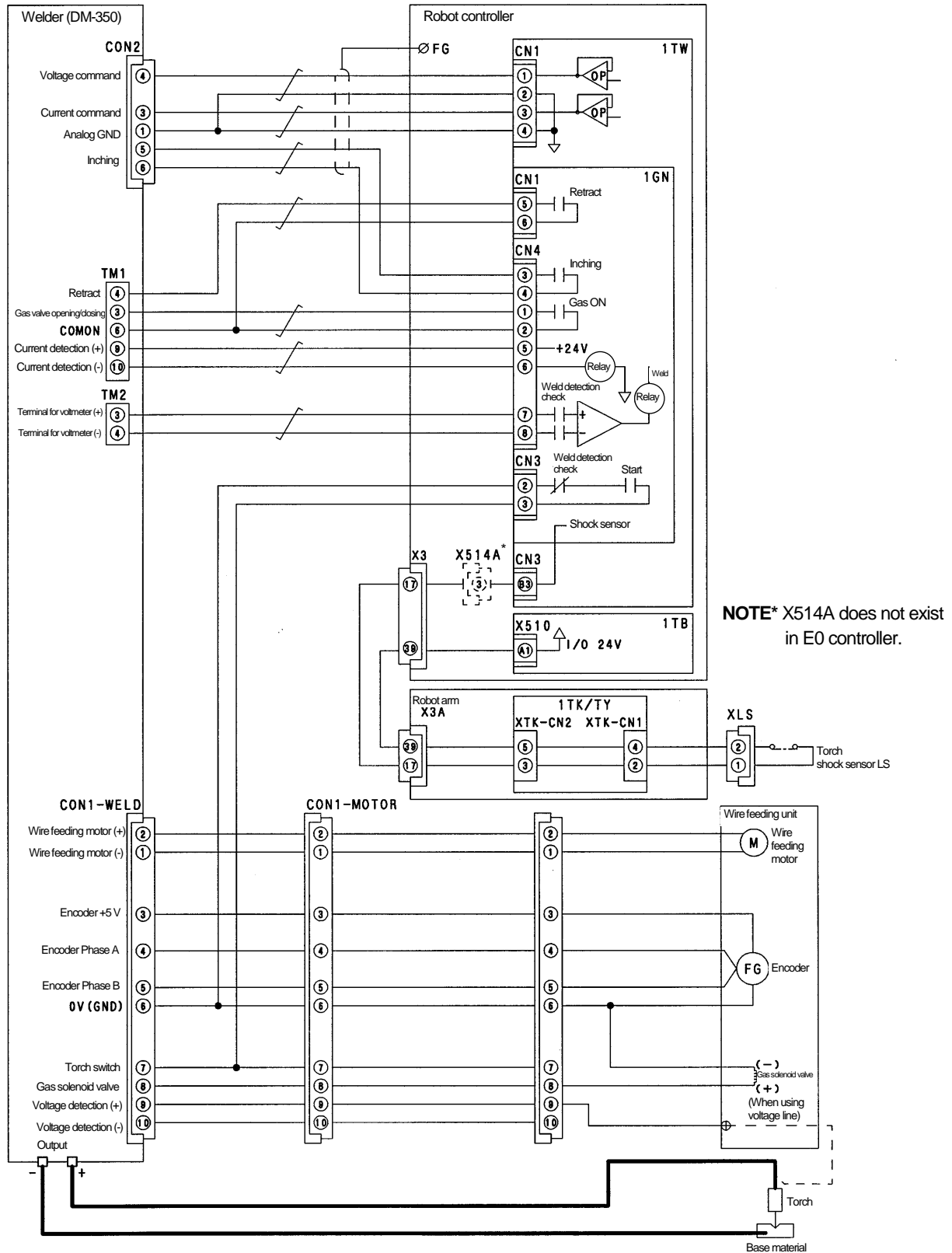


Z+direction of "Tool"

12. To check the tool dimensions registered in 11, press **INTER** to set the manual motion coordinate system to tool mode. Move the arm by pressing +/- keys of Rx, Ry, Rz and confirm that tool tip does not shift. Also, check that the torch moves in the direction shown in the left figure when pressing + key in tool mode.
  
13. Register the actual wire extension used when teaching with the controller and cut the wire to that length. Then, check the wire extension in the same way in 12 above.

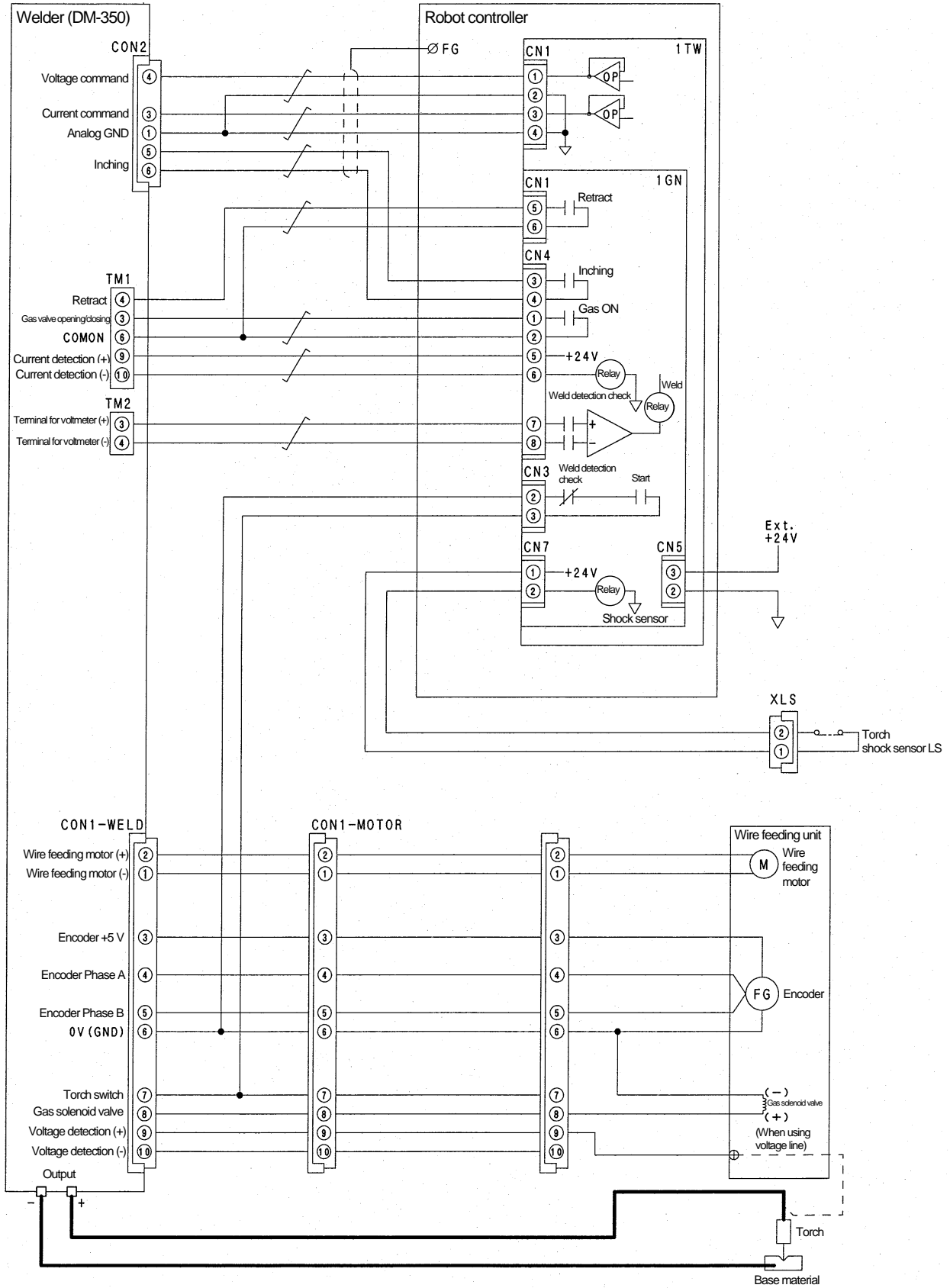
**APPENDIX 1.0 CONNECTION DIAGRAM WITH WELDER (DM-350)**

1. RA06L, RA10N/L, RA20N





2. RA05L



## APPENDIX 2.0 WELDER INTERFACE BOARD

### 1. Connector specifications

Board	Connector No.	Pin No.	Signal Name	Function	Connector	
ITW	CN1	1	V_COMMAND	Voltage Command (0-15 V)	733-108/KM (WAGO)	
		2	A15G	GND for Voltage Command D		
		3	I_COMMAND	Current Command (0-15 V)		
		4	A15G	GND for Current Command		
		5	P_RATIO	Polarity Ratio (0-15 V)		
		6	A15G	GND for Polarity Ratio		
IGN	CN1	1	WELD_ON_A	Welding in prog.. Contact Close (Output)	733-106 (WAGO)	
		2	WELD_ON_B			
		3	INCHING_C	Inching in prog. Contact Close (Output)		
		4	INCHING_D			
		5	WIRE_RETRACT_A	Wire Retract in prog. Contact Close (Output)		
		6	WIRE_RETRACT_B			
	CN2	1	I/O 24V	24V Power Supply for I/O	231-306/037-000 (WAGO)	
		2	WIRE_HOLD			
		3	GAS_SOL			Gas Valve Power Supply + (Valve side)
		4	COM			Gas Valve Power Supply - (Valve side)
		5	MOTOR_A			Wire Feeder Motor Power Supply + (Motor side)
		6	MOTOR_COM			Wire Feeder Motor Power Supply - (Motor side)
	CN3	1	MOTOR	Wire Feeder Motor Power Supply (Welder side)	231-304/037-000 (WAGO)	
		2	COM	Common for Motor and Start Valve		
		3	WELD_ON	Welding in prog. Contact Close (Output)		
		4	GAS_SOL	Gas Valve Power Supply (Welder side)		
	CN4	1	GAS_ON_A	Gas Supply in prog. Contact Close (Output)	733-110 (WAGO)	
		2	GAS_ON_B			
		3	INCHING_A	Inching in prog. Contact Close (Output)		
		4	INCHING_B			
		5	B24V	24V Power Supply for Welder Interface		
		6	ARC_DETECT	Arc Generation in prog. Contact Close (Input)		
		7	WIRE_STICK+	Wire Stuck Detection 15 V Supply		
		8	WIRE_STICK-	GND for 15 V Wire Stuck Detection		
		9	B24V			
		10	TORCH_SHORT			
	CN6	1	TOUCH_SENCE	Touch Sensing in prog. Contact Close (Output)	733-104&733-100 (WAGO)	
		2	I/O 24V	24V Power Supply for I/O		
		3	I/O 24G	24V GND for I/O		
		4	WIRE_TOUCH	Wire Touch in prog. Contact Close (Output)		
CN7	1	B24V		733-102 (WAGO)		
	2	TORCH-LS				
CN8	1	I/O 24V	24V Power Supply for I/O	733-105 (WAGO) Reserved		
	2	I/O 24G	24V GND for I/O			
	3	WELDER_ERR1	Welder Error 1			
	4	WELDER_ERR2	Welder Error 2			
	5	WELDER_ERR3	Welder Error 3			

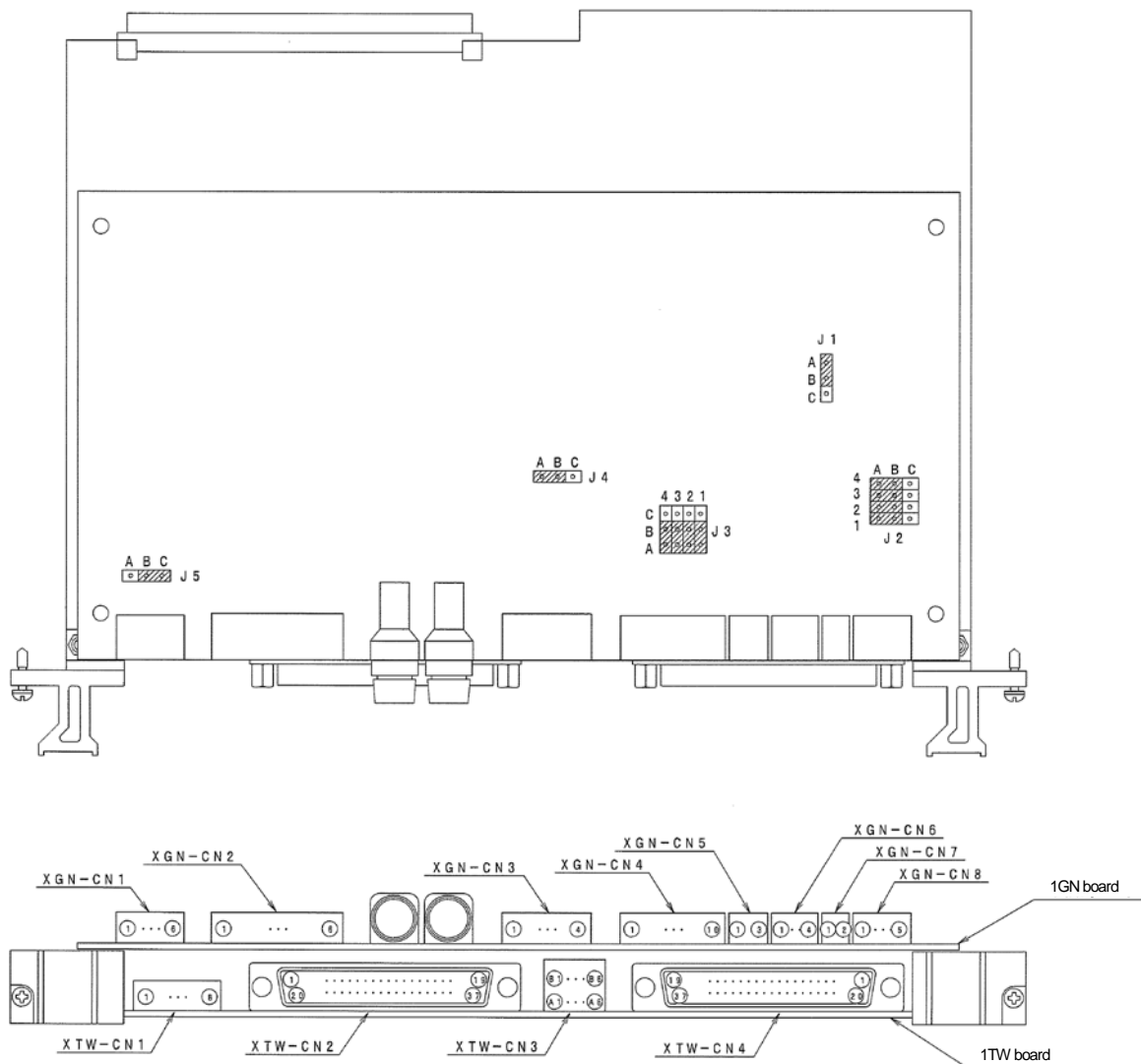
**[ NOTE ]**

A15G, I/O24G and B24G are insulated respectively.

2. For RA05L, input DC28V power to the following connector.

Board	Connector No.	Pin No.	Signal Name	Connector
1GN	CN5	2	29G	733-103 (WAGO)
		3	29V	

2. Appearance



Appearance of 1GN + 1TW Boards

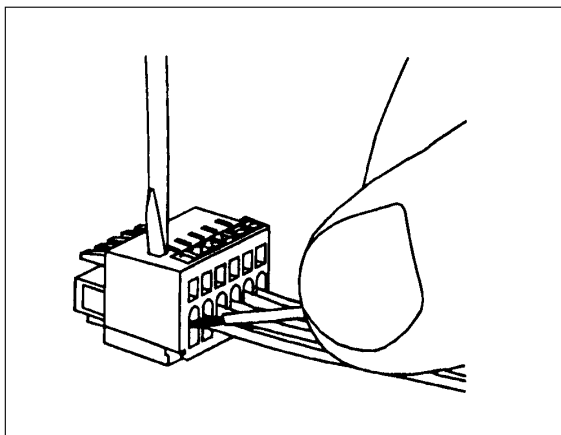
Jumper setting

No.	Content	Setting
J1	Common switching for NO_GAS, NO_WATER and NO_WIRE signals	A-B jumper: I/O24V for input common, SOURCE/PNP spec. (standard) B-C jumper: I/O24G for input common, SINK/NPN spec.
J2	Exclusive for system	A-B jumper (cannot change)
J3	Exclusive for system	A-B jumper (cannot change)
J4	Exclusive for system	A-B jumper (cannot change)
J5	Retract interlock switching (only available for CN1)	A-B jumper: Inching is possible during retracting B-C jumper: Inching is not possible during retracting (standard)

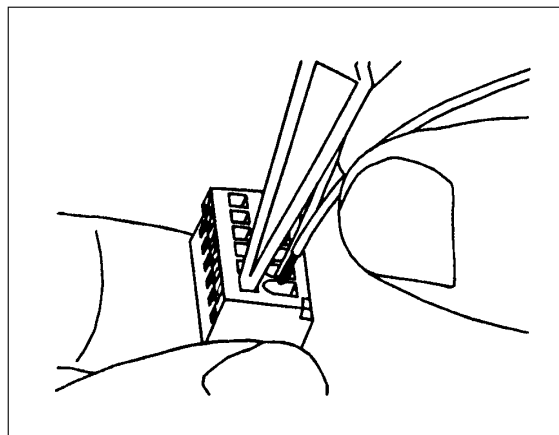
### 3. Connection of Cage Clamp

Board	Connector No.	Cross section		Stripped length
1TW	CN1	AWG28-20	0.08 - 0.5 mm <sup>2</sup>	5 - 6 mm
1GN	CN1, 4, 5, 6, 7, 8	AWG28-20	0.08 - 0.5 mm <sup>2</sup>	5 - 6 mm
	CN2, 3	AWG28-12	0.08 - 2.5 mm <sup>2</sup>	8 - 9 mm

Connect wire leads as shown in figures below.



Connecting conductive wire from the side  
 - via screwdriver (2.5×0.4) mm



Connecting conductive wire from the top  
 - via tool WAGO 233-332 for WAGO Series 733  
 - via screwdriver (2.5×0.4) mm for WAGO Series 231

## **APPENDIX 3.0 DEFORMATION OF WELDING TORCH AND REPLACEMENT**

During welding by the robot, the welding torch may interfere with the workpiece due to an unexpected trouble, and this may result in bending or damage to the torch. In this case, repair or replace the torch and adjust it as described below.

### **TORCH ADJUSTING METHOD USING A FIXED TEACHING POINT**

After completing installation and adjustment of the robot and the jig, mark a point on a stationary section of the jig. Then teach the wire tip so as to face vertically with the wire extended to the length used when welding. It is recommended to give a name to the teaching program, which is distinguishable from other programs.



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**Kawasaki Robot Controller E Series**  
**INSTALLATION AND CONNECTION MANUAL**  
**-Arc Welding-**

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